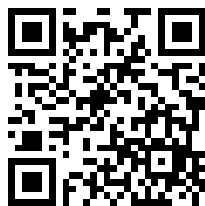


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**Journal**  
**of the**  
**Royal Army Medical Corps**





# Journal

OF THE

# Royal Army Medical Corps

EDITED BY

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTANT EDITOR :

COLONEL D. T. RICHARDSON, M.C.

MANAGER :

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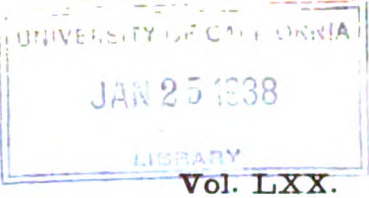
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No. 1

January, 1938.



# Journal

OF

THE

## Royal Army Medical Corps

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MONTHLY



EDITOR.

COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTANT EDITOR.

LIEUTENANT-COLONEL D. T. RICHARDSON, M.C., R.A.M.C.

MANAGER.

MAJOR W. J. F. CRAIG, R.A.M.C.

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WAZIRISTAN OPERATIONS, 1937.<sup>1</sup>

NOTES ON THE USE OF AIR TRANSPORT FOR THE EVACUATION  
OF CASUALTIES.

BY BREVET-COLONEL GORDON WILSON, O.B.E., M.C.  
*Royal Army Medical Corps.*

AIR TRANSPORT OF SICK AND WOUNDED.

THE use of air transport for the evacuation of sick and wounded in war is no innovation and its adaptability and advantages for this purpose have been proved beyond doubt in past years, particularly by the French in Morocco and Syria.

During the present operations in Waziristan, aircraft have been utilized for the first time in the annals of warfare on the North-West Frontier of India for the purpose of evacuation of casualties. Owing to the small number of suitable aircraft available, the extent of the employment has necessarily been limited, but it is hoped that the following account of the experiences gained may add to the evidence in favour of an early extension of the use of air transport as an accepted adjunct to the resources of the military Medical Services in war and in peace.

KHAISORA VALLEY OPERATIONS, 1936-37.

In the end of November, 1936, British columns from Razmak and Bannu legitimately moving into the Khaisora Valley were attacked by

---

<sup>1</sup> This article covers the period up to June 30, 1937.



Tori Khel Wazirs and other tribesmen and sustained severe casualties. A reinforcement of one Brigade was despatched from the Northern Command and the Khaisora Valley was successfully penetrated, a strategical road being constructed *pari passu* with the advance. Comparatively little opposition was met with and by the middle of January, 1937, the tribesmen were brought to terms and the reinforcing Brigade was withdrawn.

On the occasion of the original attack by tribesmen, when the columns were isolated for a day or two before organized withdrawal, supplies of antitetanic and antigas-gangrene serum were dropped by aircraft to supply urgent requirements.

During the operations aircraft were not utilized for the transport of casualties.

#### WAZIRISTAN OPERATIONS, 1937.

The cessation of hostilities arranged in January, 1937, was, however, short lived and early in February a series of unprovoked outrages by tribesmen occurred, including the murders of two British officers.

The situation then rapidly deteriorated and it became imperative to reopen operations on a very considerable scale.

The normal garrison of Waziristan consists of approximately three Brigades and ancillary units, but, by March, 1937, this had been reinforced by the whole of the 1st Indian Division from the Northern Command, and at a later date by an infantry brigade and additional artillery, tank corps and ancillary units.

All incoming formations and units brought a proportion of medical units and regimental medical personnel.

#### *Principles of Evacuation of Casualties.*

Under the direction of Major-General W. H. Hamilton, D.D.M.S., Northern Command, a new system was introduced, entirely different from that adopted in previous operations on the North-West Frontier.

It was argued that peace hospitals existed with sufficient beds to accommodate the sick during the worst season of the year and, therefore, this accommodation should suffice for the most healthy period (i.e. period during which operations were taking place), leaving an adequate margin for any likely casualties. The whole depended on efficient administration and a system of regular and daily evacuation. Existing hospitals with their amenities and medical staff were utilized. This procedure obviated the necessity for increasing the base hospitals at Rawalpindi by thousands of extra beds with the attendant equipment and staff and, furthermore, eliminated Base Convalescent Depots for Indians. Those who know Indians with their various creed and caste difficulties will realize what an undertaking it is to organize and staff a large convalescent depot for Indians. The difficulties regarding food, clothing and equipment for men from various units, the unfamiliar surroundings and the lack of

discipline, have all been avoided by returning patients to hospitals in their own Cantonments from which, when fit for discharge, they are sent to their own unit lines, amongst their own caste friends and relations, with their own womenfolk to cook their food, and come under their own unit for discipline and equipment.

In implementing this system casualties had to be considered under two headings :—

(a) *Those from the Normal Garrison of Waziristan.*—Orders were issued for the retention in military hospitals in Waziristan of as many as possible of the sick and wounded of units belonging to the normal garrison of Waziristan. The object of this was to utilize fully the excellent hospital accommodation which exists in peace in Waziristan and to enable discharges from hospital to go to their unit depots in the district. A proviso to this permitted the evacuation ex-Waziristan to Rawalpindi of selected serious sick and wounded who required special treatment.

(b) *Those from Formations and Units sent into Waziristan for the Operations.*—Of this category, all, with the exception of those likely to be fit in seven to ten days, were evacuated ex-Waziristan to base hospitals in Rawalpindi. On arrival in Rawalpindi as many as possible were distributed to the hospitals in their normal peace stations in the Northern Command. Casualties from units (a small number) whose peace stations were located outside the Northern Command, e.g. in the Eastern Command or Southern Command, were retained in Rawalpindi, and on discharge from hospital were accommodated in a special reinforcement camp in Rawalpindi.

The distribution of Indian casualties was carried out in specially equipped railway ward cars (capacity of twenty-eight) attached to passenger trains running to normal timings.

In the case of British troops, those fit to travel were, from April 9 on, transferred thirty-seven miles by road to the British Military Hospital, Murree (about 7,000 feet), in the Murree Hills, in which the unit depots are located in the hot season. For discharges from the British Military Hospital, Rawalpindi, and the British Military Hospital, Murree, a small convalescent camp of one hundred beds was established in barracks at Gharial, a few miles from Murree and in delightful surroundings from which, in due course, men returned to their depots.

The effect of the procedure outlined has been to do away with the necessity for a very large expansion of hospital accommodation in Rawalpindi, and the only expansions found necessary up to date have been an increase of 100 beds in the Indian Military Hospital, Rawalpindi, and 25 beds British at the Combined Indian Military Hospital, Kohat (medical railhead), and the formation of a British Convalescent Camp of 100 beds at Gharial.

It is to be understood, however, that to cope with the daily needs of the large influx of troops into Waziristan it has been necessary to expand the key hospitals at Razmak and Bannu with minor increases elsewhere. In addition, to prevent unnecessary evacuation ex-Waziristan of light cases referred to above, a convalescent camp of 150 British and 400 Indian beds has been established in barracks in Razmak. On the same principle in Bannu a rest camp adjacent to the Combined Indian Military Hospital takes all light cases on discharge.

It has, therefore, been possible by a strict control of steady and daily evacuation to obtain a full and economical use of existing hospital accommodation over a wide area, in preference to a huge and costly expansion of existing hospitals in the Rawalpindi Base into local barracks.

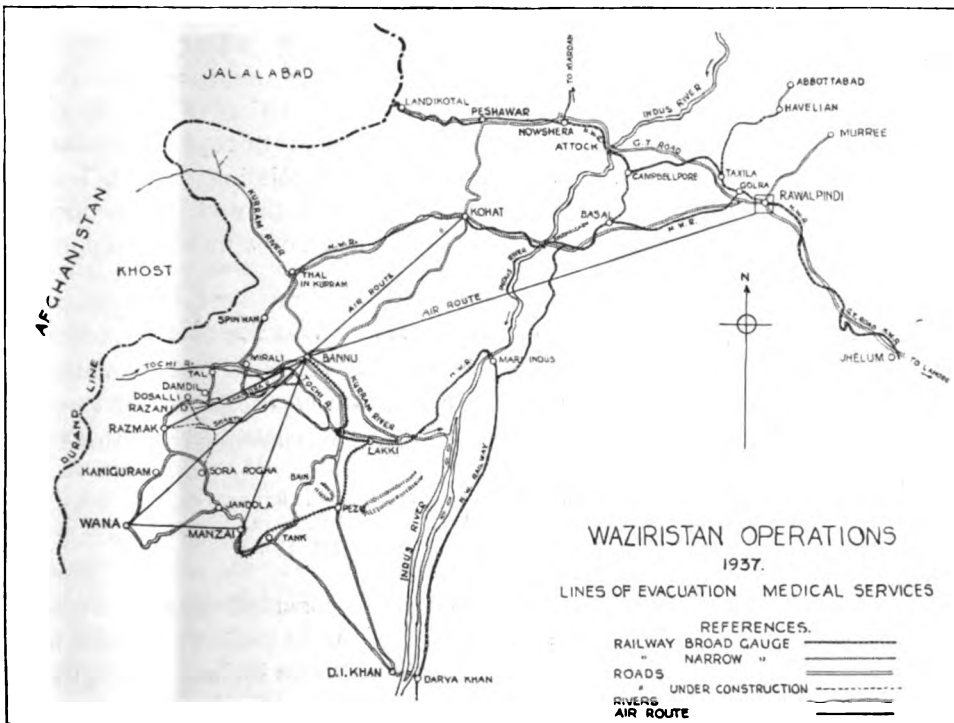
(It will be realized that the conversion of barrack blocks for hospital purposes involves large expenditure on wiring for electrification, provision of fans, provision of special bathing and latrine annexes, laying on of water supply, cementing of floors, fly proofing, and in many cases alterations to ceilings and roofs.)

#### *Lines of Evacuation.*

The diagrammatic map will indicate the peculiar difficulties of evacuation from Waziristan when it is realized that the narrow-gauge railway which extends from broad-gauge railhead at Mari Indus to Bannu and Manzai is totally unsuitable for medical purposes. The rolling stock is not adapted for the transport of sick and wounded, timings are slow (the journey from Bannu to Mari Indus takes eight hours—distance eighty-nine miles), and in the hot weather, with shade temperatures up to 125° F., the evacuation of casualties would be fraught with great dangers. Night evacuation is not feasible owing to possible enemy action. Similarly, the branch line to Manzai, subject to hostile interference in the Pezu Pass and elsewhere, can be ruled out. The narrow gauge line is only adapted for supply purposes or the carriage of healthy men. Access to the broad-gauge line at Darya Khan is feasible from October to April, when the Indus can be crossed by specially constructed boat bridges, but this route is only suitable for evacuation from the Wana-Manzai-D.I. Khan line of South Waziristan.

We are, therefore, left in the present operations with one practicable line of evacuation ex-Waziristan, i.e. by road from Bannu to Kohat, which is on the broad-gauge line, Kohat becoming medical railhead. The distance from Bannu to Kohat by road is seventy-nine miles, including a considerable proportion of hill section, and the railway journey from Kohat to Rawalpindi occupies seven hours forty minutes (a hundred and ten miles). (Specially equipped railway ward cars are utilized for the accommodation of patients on this journey.)

The road to Kohat *via* Mir Ali—Spinwam and Thal-in-Kurram passes through a disturbed area and has not been available for evacuation purposes, but in other circumstances would present useful possibilities. Bannu, therefore, may be regarded as the Advanced Base for Waziristan and the bottle neck through which all road evacuation ex-Waziristan must take place. Its peculiar importance during the operations in the Khaisora and later in the Sham Plain is evident from the map, particularly in the latter case, since at that particular time the road from the Dosalli to Razmak was closed due to hostile action and no use could be made of the excellent



hospital accommodation in Razmak (6,500 feet), with its great climatic advantages. Road distances are marked on the map and impress one immediately with the unavoidably long road journeys to which casualties are subjected when transferred to Bannu and thence to Kohat.

If we add to this the delays associated with a strict convoy system, the discomfort of road travel on hill sections with many zig-zag bends, and the intense heat of the lower stretches, it will be realized how naturally thoughts were turned to the obvious alleviation of the situation which air transport, and air transport alone, could bring. The objective was not air transport for all, but air transport for those serious cases in whose

rapid removal in comfort to the amenities of specialist treatment and skilled nursing lay their greatest chance of recovery.

It may be asked why serious casualties were not retained in Bannu, and the answer is, for climatic and nursing reasons. From April to November the climate of Bannu (1,250 feet) is peculiarly trying, prickly heat is rife, and being intensely hot and "sticky" for prolonged periods it cannot be regarded as a suitable place for the retention of serious casualties in the hot season.

It may be noted at this stage that road evacuation has been carried out by motor ambulance section cars provided with special khas-khus coverings, advocated by the D.D.M.S. Northern Command, which have been successful in mitigating the heat of the sun acting directly on canvas hoods and increasing comfort by adjusting the humidity inside the car. This arrangement, together with the provision of ice in each car, has done much to lessen the climatic discomforts of road evacuation.

It is not necessary here to describe the negotiations which led to aircraft being used for medical purposes in Waziristan, and it is proposed to proceed direct to a brief description of our experiences under appropriate headings.

#### *Type of Machine Used and Accommodation Provided.*

During the present operations in Waziristan, the Vickers Valentia Bomber Transport<sup>1</sup> has been used on a number of occasions for the air transport of sick and wounded. The internal measurements of this type of aircraft are :

Total length of cabin .. ..	22 ft. 6 in.
Total breadth of cabin.. ..	4 ft. 0 in.
Total height of cabin .. ..	5 ft. 11 in.

There is a square opening in the nose of the machine through which a loaded stretcher with Thomas' splint fittings can be passed with ease into the cabin, and there is a small door three feet seven inches in height in the port side of the cabin at the tail end. (See photographs.)

For medical purposes four lying and five sitting and one attendant, together with kits and medical equipment, can be accommodated without difficulty.

As Bomber Transport aircraft have been based at Kohat and Risalpur, it will be seen that the possibilities of "back loading" have been fully utilized. The diversion to Rawalpindi on special occasions has, owing to the short distance involved, made little or no difference to the normal movement of the aircraft concerned.

---

<sup>1</sup> Two types were used : Vickers Valentia (India) Pegasus II.M.3. and Vickers Valentia (Iraq) Pegasus II.L.2, with cruising speeds of 98 m.p.h. and 80 m.p.h. respectively.

## THE NUMBER OF CASES EVACUATED—THEIR ORIGIN AND DESTINATION.

Origin	Destination	Date	Numbers evacuated		
			B.Os.	B.O.Rs.	Indians
Manzai	Kohat	19.4.37	—	—	1
Wana	Bannu	24.4.37	—	—	7
Bannu	Kohat	27.4.37	—	1	2
"	"	27.4.37	—	3	3
"	"	5.5.37	—	—	9
Razmak	"	7.5.37	—	—	1
Bannu	Rawalpindi	10.5.37	2	1	6
"	"	12.5.37	—	—	5
"	"	26.5.37	1	2	6
Wana	Bannu	2.6.37	—	—	7
Bannu	Rawalpindi	2.6.37	—	6	2
Wana	Manzai	4.6.37	—	1	—
Bannu	Rawalpindi	9.6.37	—	4	4
Wana	Manzai	10.6.37	—	—	1
Bannu	Rawalpindi	18.6.37	1	—	—
Wana	Manzai	20.6.37	1	—	—
Manzai	Kohat	20.6.37	1	—	—
Wana	Bannu	25.6.37	—	—	7
"	"	6.7.37	—	3	5

*The Type of Case Selected for Air Transport.*

*Lying Cases.*—Broadly speaking, the type of case selected is that for which immediate specialist treatment and skilled nursing are essential under conditions conducive to rapid recovery, i.e. the type of case which without these amenities is liable to fatal complications or a subsequent serious degree of permanent disability. Rapid evacuation by air transport to suitable hospitals, thereby obviating the delay and discomfort of long road and rail journeys, has a profound psychological effect on patients in this category. It increases their morale and may thus be a deciding factor in their recovery.

The majority of cases so defined are surgical, but certain types of medical cases are particularly suited for early evacuation by air transport.

*Sitting Cases.*—The selection of sitting cases depends, to a considerable extent, on the type of casualty available at the time the aircraft is to make its journey. As a general rule sitting cases are selected from the lighter cases which are unlikely to be fit for duty within four to five weeks. Cases of gunshot wounds of the upper extremity, suitably splinted, can travel comfortably in a sitting posture as also can the less serious cases of wound or injury to the lower extremity. No hard and fast rule can be made in the selection of this type of case and each case should be judged on its merits in accordance with the necessity of the situation.

The following brief account gives the best indication as to the selection of lying cases.

*Case A.*—An officer was severely wounded in action at Dosalli. The bullet entered his face on one side, traversed the tongue and made its exit through the lower jaw on the other side, removing a large piece of the lower maxilla and leaving a large gaping wound.

Wounded on May 8, 1937, and evacuated to Bannu by road, he was transported early on the morning of May 10 by air from Bannu to Rawalpindi and thence by motor ambulance car to the British Military Hospital, Murree. The air journey took one and a half hours and the road journey from Rawalpindi to Murree two hours.

His condition was serious in the extreme, but with specialist surgical and dental treatment and skilled nursing under excellent climatic conditions he is now making a remarkable recovery. In view of the very serious danger in this case of a complication such as septic pneumonia, it is held that this officer's life was saved by his expeditious evacuation to Murree.

Under no circumstances could he have stood the road and rail journey from Bannu to Murree and had he remained in Bannu climatic conditions might have precluded his chance of recovery.

*Case B.*—An Indian other rank received a severe gunshot wound in the abdomen in the action on April 9, 1937, at Shahur Tangi. He was evacuated by road to Manzai, where he was operated on in the Combined Indian Military Hospital, Manzai; it became essential to remove him to surroundings with the amenities indicated above, especially skilled nursing. He was transported by air from Manzai to Kohat on April 19, 1937, and subsequently transferred to Rawalpindi. He withstood the air journey to Kohat very well and arrived there in good condition despite his very serious state. Had he been evacuated by road from Manzai to Bannu there is little doubt that he would not have survived.

He is now progressing satisfactorily.

*Case C.*—An officer suffering from effects of heat was evacuated from Manzi to Bannu by air and thence to Rawalpindi by air. After arrival at the British Military Hospital, Murree, somewhat cyanosed and partially conscious, he stated that the most trying part of his journey was the two hours road journey from Rawalpindi to Murree. The remarkable improvement in his condition within twenty-four hours of his arrival in Murree is a strong argument for the transport of such cases by air.

Patients for transport by air are given a suitable meal before emplaning and such hot drinks or stimulants as are required on the journey are carried in thermos flasks. Stretcher cases are suitably clad in hospital clothing; an adequate supply of blankets is necessary owing to the considerable drop in temperature at cruising altitudes. To give a greater sense of security a broad central strap should be applied over the patient and underneath the stretcher. A small supply of medical equipment, dressings and stimulants is carried by the attendant.

Excellent fittings are available in the cabin equipment whereby two stretcher cases can be slung from the roof, and beneath these, on the same side of the cabin, two lying cases can be accommodated, with or

**Rack for Haversacks, etc.**

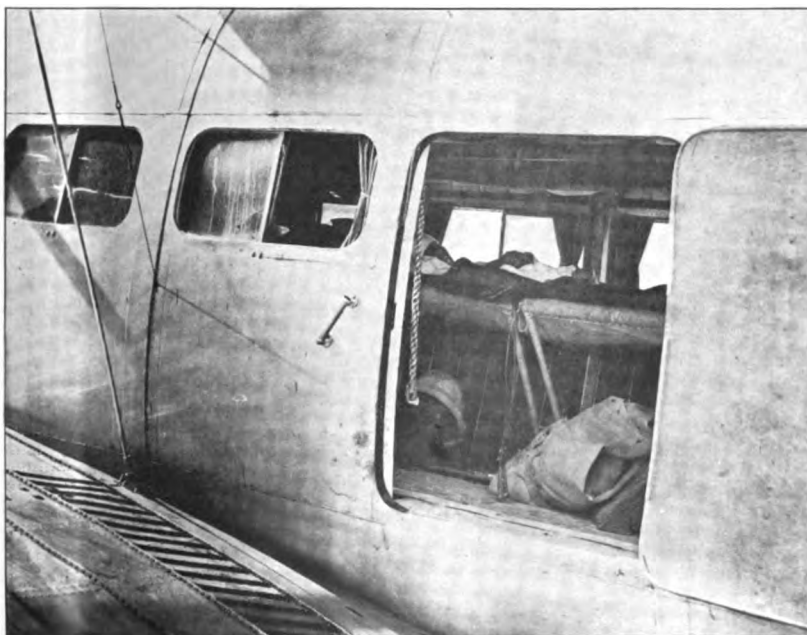
**Folding seats  
used for  
sitting cases**



**Upper  
stretcher  
fittings**

**Folding seats  
for lower  
lying cases**

**FIG. 1.—Looking forward, interior of Vickers Valentia bomber transport.**



**FIG. 2.—Shows lower lying case.**



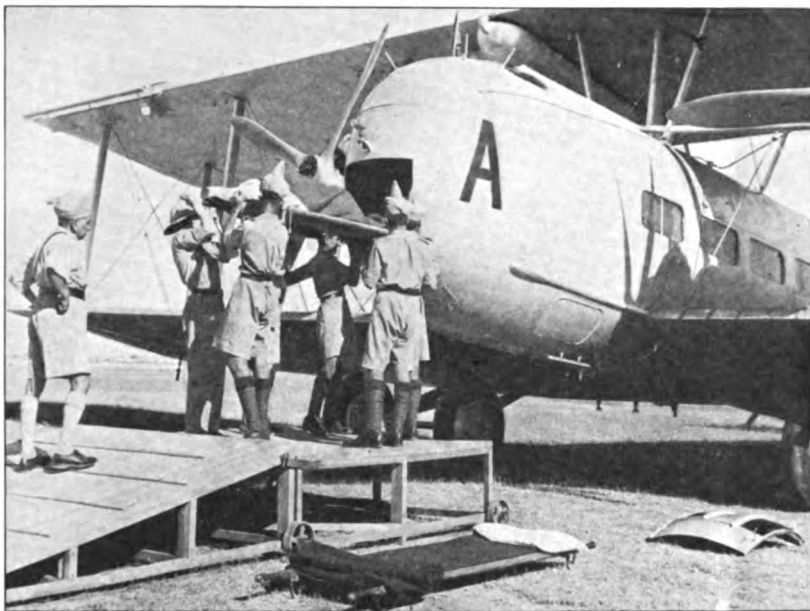


FIG. 3.—Loading.



FIG. 4.—Off-loading sitting cases by side door.

without stretchers, on the folding lateral seats provided. The sitting occupy folding seats provided on the other side of the cabin, the upper portion of which has racks for haversacks.

The method of using the accommodation is shown in figs. 1 and 2. A lavatory fitting can be provided at the tail end of the cabin.

Stretcher cases are loaded through the opening in the nose of the cabin, but, owing to the height of this opening from the ground, it is essential to use a broad portable ramp to facilitate loading and off loading (fig. 3).

Sitting cases enter and leave the machine by the side doorway (fig. 4).

The order of loading is as follows: (1) Upper aft stretcher case; (2) lower aft stretcher or lying case; (3) upper forward stretcher case; (4) lower forward stretcher or lying case; (5) sitting cases through the side doorway.

All stretcher cases are loaded feet first.

When all cases are loaded the attendant has adequate accommodation for himself and ready access to patients. After each journey the attendant, generally an Assistant Surgeon or trained nursing orderly, submits a brief report in which points affecting the comfort and reactions of the patients are noted.

Careful inquiry has been made in hospitals from patients who have been transported by air and the almost universal opinion is that this means is vastly preferable to motor ambulance or rail transport. There have been very few cases of air sickness and no complaints have been received as to discomfort in taking off or landing. A number of patients report that they slept throughout the journey.

#### GENERAL REMARKS.

The method used in Waziristan really amounts to opportune "back loading" of Bomber Transport aircraft and has caused the minimum dislocation of the normal functions of the aircraft used.

An ideal method would involve a definite allocation of aircraft for the specific use of the Medical Services, but this is quite out of the question in India at the present day with its limited establishment of Royal Air Force. Much, however, can be done by the method which has been used and it has demonstrated its practical use in such a manner as to justify its employment in future operations in India.

The use of air transport in civil life for medical purposes is rapidly extending, particularly in Canada and Australia, where surface transport presents difficulties in outlying districts. In Europe much attention is now being drawn to it and one has noted with great interest the recent meeting of the First International Conference on Aerial Relief at Budapest under the auspices of the League of International Red Cross Societies in

conjunction with the Hungarian Red Cross. Twenty-five nations (including Great Britain) and fifty organizations took part.<sup>1</sup>

We all recognize the initiative of the recognized voluntary aid societies in the formation of air ambulance detachments. Such activities cannot fail to hasten the general acceptance of organized air transport for medical purposes, and it is to be hoped that in the near future a concrete organization will materialize in the Army for its employment in war by the military Medical Services.

With regard to the use of aircraft in Waziristan, no difficulty arose in establishing a close liaison with the Royal Air Force who co-operated most readily and took the greatest interest in the humanitarian task which was added to their normal duties. A careful system of intercommunication as to the moves of aircraft being used was found to be absolutely essential to avoid delay in loading aircraft or delay in meeting aircraft with ground parties and motor ambulance cars.

On a number of occasions medical supplies were dropped on outlying camps, and in one particular instance a case of cobra bite was successfully treated owing to the timely arrival by air of the necessary anti-venene. When Wana was isolated and no road communication possible the D.D.M.S., Northern Command, made a rapid visit by air to investigate the condition of the wounded from the Shahur Tangi action.

The use of aircraft for medical purposes has been highly commended by the individuals transported, but in addition, the principle seems to have met with approbation by all ranks in the Field. Details of its use and photographs were published in the Indian Army newspaper "Fauji-Akhbar" so that all Indian troops were aware of its adoption.

#### CONCLUSION.

The foregoing notes are admittedly limited in their scope. They represent experiences of air transport of casualties in operations on the North West Frontier of India, involving a relatively trivial number of battle casualties. Nevertheless the experience gained confirms the advantages, physical, moral and psychological, to be derived from the use of aerial transport for medical purposes in war. No arguments are necessary as to the adaptability of aircraft for the specific purposes of carrying sick and wounded; many types exist which can provide the requisite accommodation and comfort. Of military aircraft, the Bomber Transport and the Troop Carrier can, with minor fittings which in no way interfere with their normal functions, be readily adapted for medical purposes.

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<sup>1</sup> See brief report by Colonel E. M. Cowell, D.S.O., of the Survey Branch of the British Red Cross Society in the *British Medical Journal* of June 26, 1937.

At the present time it can be appreciated that the necessity for rapidly developing an efficient air arm has overshadowed the consideration of the ancillary purposes to which air transport may be applied in war. That the latter have not been overlooked is evident; for example, in the extensive use of aircraft by the Italians in Abyssinia for dropping supplies, war material and medical equipment.

In Waziristan large quantities of supplies have been conveyed by aircraft to isolated camps when the use of road communications would have necessitated inconvenient and uneconomical military dispositions. Similarly, personnel have been transported on many occasions. We may reasonably assume that the use of air transport for such purposes is certain to be considerably extended in the near future, particularly in operations where the protection of road convoys necessitates an undue dispersal of troops.

One can visualize drastic reductions in the size of the "tail." Given suitable landing ground facilities, the problem of the Medical Services will undergo considerable change. It should be possible, with the use of an adequate number of aircraft, to eliminate a proportion of immobile medical units on the Lines of Communication, and serious casualties will be conveyed with great speed and comfort to centralized hospitals well outside the operation area where every amenity and good treatment are available.

The Medical Services are naturally swayed by the humanitarian advantages to be gained from the use of air transport, but there is much evidence to indicate that its recognition by the military authorities for medical purposes in war will result from their greater appreciation of its economic possibilities and its particular suitability for use in certain terrain.

I have to thank Major-General W. Haywood Hamilton, C.B., C.I.E., C.B.E., D.S.O., K.H.P., D.D.M.S., Northern Command, for permission to prepare this article and for his contributions to its substance. It is entirely due to his efforts in securing the support of the Army Commander and General Staff that aircraft have been placed at the disposal of the Medical Services during the Waziristan Operations 1937.

I am indebted to Lieutenant-Colonel J. Walker, M.C., R.A.M.C., and to Sub-Conductor J. Dunn, M.E.S., Rawalpindi, for their excellent photographs.

To Lieutenant-Colonel T. O. Thompson, R.A.M.C., A.D. of H. & P., Northern Command, I owe suggestions as to the best method of loading the type of aircraft used.

The portable ramp shown so clearly in fig. 3 was designed by Sub-Conductor J. Dunn, M.E.S.

## THE COLIFORM BACILLI AND WATER SUPPLIES.

BY MAJOR E. F. W. MACKENZIE, O.B.E. M.C.

AND

MAJOR F. C. HILTON-SERGEANT.

*Royal Army Medical Corps.*

### I.—INTRODUCTION.

A SINGLE bacteriological examination of a water does no more than prove that, at the time when the sample was drawn, organisms which could be grown in the artificial culture media employed were or were not present, and permit of an approximate estimate of their numbers.

A negative result is no guarantee that the water examined will remain in a similar condition for any specified time unless there is, of a certainty, no material change in conditions, when such an assumption may be justified.

The more frequently the water is examined, and the longer the periods over which such examinations reveal no evidence of pollution, the greater becomes the probability that the supply is a constantly safe one. Nevertheless it would be difficult to assert that any source of water would remain free from suspicion under all conditions. For this reason routine bacteriological examinations should be performed at regular intervals, and special ones whenever any changes in meteorological or other conditions take place which might conceivably influence the purity of the supply.

In the Army it is possible to adopt these examinations as a routine only in permanent or semi-permanent stations. In all other phases of Army life an opinion on the desirability or otherwise of any source of drinking water is a matter of sufficient urgency to preclude any prolonged bacteriological examinations. The only practicable procedure is, at the most, a detailed examination of the source, followed by assessment of the probability of dangerous pollution and by a single bacteriological and possibly also a chemical examination of the water.

In the past great reliance was placed upon chemical examination. With advancing knowledge bacteriological examination has played an increasingly important and chemical analysis a less important part in water testing. In the Army, moreover, it will frequently be found difficult to obtain an accurate chemical analysis, whereas bacteriological examination is usually possible.

### II.—THE BACTERIOLOGICAL EXAMINATION OF WATER SUPPLIES.

Apart from occasional endeavours to isolate specific pathogens, the bacteriological examination of water includes the following routine tests:—

(1) *Total colony counts*: (a) The agar count at 20° to 22° C. (b) The agar count at 37° C.

(2) *The coliform count.*

(3) *The identification of faecal streptococci.*

(4) *The identification of Clostridium welchii.*

The agar count at 20° to 22° C. may advantageously replace the gelatine count since liquefaction of gelatine alone has no special significance.

(1) *The total colony counts* are of value as a routine procedure in the control of any particular water supply, since they indicate departure from the normal or breakdown of purification processes. In a single examination of a source of supply for immediate use they give little or no help, since no definite standards can be laid down and any ratio of the 22° C. count to that at 37° C. which might be laid down would be subject to so many variations and exceptions as to be of little or no value.

(2) *The Coliform Count.*—The presence of organisms of the coli-aerogenes group in water can be determined by their production of acid and gas in MacConkey broth. A result is obtained in forty-eight hours and is recorded as indicating the presence or absence of “presumptive coli” in measured quantities of the water under test, or more conveniently, the number present in 100 millilitres of the sample.

The term “presumptive coli” is unfortunate and misleading since a large proportion of the organisms which give rise to a positive result are not *Bact. coli*, nor are they typically inhabitants of the colon. Since, owing to the indefinite character of the test, it is advisable to use an omnibus term, the more recently introduced “coli-aerogenes” or better still, “coliform organisms” as used by Topley and Wilson (1936) is to be preferred. Nevertheless the method has stood the test of time and until recently was undoubtedly the most reliable short cut to forming an opinion on a water provided its indications were tempered by a thorough inspection of the source and the careful assessment of the probability of dangerous pollution.

If the inspection was satisfactory and “presumptive coli” was absent from reasonable quantities of the water the examiner could pronounce it a safe supply.

If the “presumptive coli” test showed the presence of coliform organisms in comparatively large numbers but inspection revealed no source of pollution, it was presumed that some hidden or intermittent source must exist and only the most courageous or foolhardy of men would give a favourable report.

Of recent years a vast amount of research has shown that the coliform group includes many organisms more or less closely related, that numbers of them are normally present in unpolluted soils, grasses, grains, water, etc., and that all give a positive “presumptive coli” test. For this reason the value of the test is now generally recognized as limited and the sanitarian demands, with increasing frequency, the further identification of the coliform organisms responsible for a positive presumptive test.

The necessity for this further differentiation is, to some extent, dependent

upon the frequency with which non-fæcal coliform organisms may exist in water in the absence of fæcal *Bact. coli*. Bardsley (1934) found this to be the case in only 7·84 per cent of all samples and in rather more than 15 per cent of samples which gave a positive presumptive reading. She concludes that it is doubtful if further tests beyond growth in MacConkey broth at 37° C. can be justified in routine analysis in England. This will be referred to subsequently and it is sufficient to record here that her findings do not accord with those in other countries, where the majority of organisms giving a positive presumptive reading in apparently unpolluted waters prove, on further investigation, to be typically non-fæcal in origin.

While the presence of the non-fæcal types in the absence of fæcal coli cannot at present be ignored in routine control of water supplies, they are significant only in so far as they may indicate the possibility of dangerous pollution resulting from some future change in conditions, such as heavy rainfall, by virtue of their ability to survive since such conditions last prevailed. In these circumstances a change in the ratio of fæcal to non-fæcal types may also be significant.

When, however, an opinion must be based on a single sample it is doubtful whether the non-fæcal types have any real significance in England, while in India and many other tropical or semi-tropical countries, investigators have found that the widespread distribution of non-fæcal types in Nature would result in the unnecessary condemnation of many wholesome sources of supply if the standards of the test accepted in this country were applied.

Clemesha (1912b) found that waters in India, known to have received no pollution for so long as six months, not infrequently contain from 1 to 10 coliform organisms in 1 millilitre.

Butler (1921) went so far as to state that, were water in the tropics to be judged strictly on the standards employed in England, there would probably be no water fit to drink.

In such countries the standards of the test are therefore relaxed. This is a widespread though most unreasonable practice. It is an acceptance of the principle that, because most wholesome waters contain non-fæcal coliform organisms in 10 millilitres, standards should be lowered in order to fit the test to the waters. When fæcal coli are present in more than two of five 10-millilitre tubes a water in England should be considered unsatisfactory (Thresh, 1933). The fact that a wholesome water in the tropics may normally give this result is in no way a guarantee that, in any other water, or in the same water at any other time, a similar result may not be due to recent fæcal contamination.

The application of the "presumptive coli" test to waters in tropical and semi-tropical countries thus presents grave difficulty and it is of value chiefly as the preliminary step in the further identification of the organisms giving rise to a positive result.

Lowering of the acceptable standards for this test is a recognized

procedure even in England, in the case of small supplies, and the Ministry of Health (Report, 1936) considers that, in such cases, "the discovery that the 'presumptive coli' reaction was due to the 'aerogenes' type would justify the opinion—not justifiable in the case of a large supply—that the possibility of their gross faecal contamination is sufficiently remote for their use not to be associated with risk." This statement does not suggest, as might appear to be the case, that expediency may permit the supply of a possibly unwholesome article to a few people, but not to many. Without doubt the statement constitutes a recognition of the fact that, in the light of increasing knowledge, the "presumptive coli" test has not the same significance as formerly; that the presence of organisms of the aerogenes-cloacæ group in the absence of faecal coli is of no immediate significance; but that, in the case of large supplies, no investigation which may throw any light on the past, and therefore on the possible future condition of the water, may be neglected.

(3) *The Identification of Faecal Streptococci*.—This test is of value when there is difficulty in interpreting the result of a "presumptive coli" test. It is not usually performed in routine work and recent advances in our knowledge of the coliform bacilli and methods of identifying them have rendered it less important than formerly. It cannot be considered a test of any value by itself. *Streptococcus faecalis* dies out rapidly in water. Numerous observers have recorded the absence of faecal streptococci from large numbers of samples containing *Bact. coli* and known to be polluted. (Houston, 1910, Savage, 1916.)

(4) *The Identification of Clostridium welchii*.—This sporing anaerobe is a natural inhabitant of the mammalian intestine. The spores are extremely resistant to both chemical and physical disinfecting agencies and while their presence may as a rule be accepted as indicating pollution at some distant date, they cannot be considered to be indicators of existing dangerous pollution. Their presence may be detected by the sulphite reduction test of Wilson and Blair (1925), or by the stormy fermentation test which has for long been used for this purpose. Either test may be of value as confirmatory evidence in conjunction with a positive "presumptive coli" test and a positive result from a water containing no coliform bacilli may contribute to accuracy in assessing the past history of the water.

The Eijkman test, as introduced by Eijkman (1904), depended upon the belief that *Bact. coli* but not *Bact. aerogenes* would grow and produce gas in a special glucose medium if incubated at 46° C. The test has recently been modified by Williams *et al.* (1933) and by Wilson *et al.* (1935). It will be discussed later.

Prior to the modification of the Eijkman test we had, therefore, only one simple bacteriological procedure, the "presumptive coli" test, which would, in a reasonably short time, assist us in forming an opinion upon a sample of water to the following extent. When positive, it indicates that



the water under test is not above suspicion. When negative it furnishes reliable information to the effect that the water, at the time of examination, does not contain dangerous pollution.

The value of the test is therefore strictly limited, though its significance in routine work is not to be depreciated.

In making the above generalization we must except the possibility of recent pollution with urine containing bacilli of the enteric group, and the presence of cercariæ of *Schistosoma*, neither of which types of pollution can ordinarily be recognized by any of the routine bacteriological tests of water supplies.

The sanitarian requires more information than is supplied by this test alone. He requires an answer to the question: "Are the organisms, the presence of which has been demonstrated in a water, of excretal origin and therefore indicative of recent dangerous pollution, or are they not?" In other words: "Is this a safe source of supply or is it not?"

In no sense of the word does the "presumptive coli" test provide an answer to this question and the value of the evidence given by it in assisting us to find an answer would appear to vary in different localities. There is some evidence to the effect that in England the proportion of false presumptive tests may not be unduly high, but in other countries coliform bacilli of non-fæcal origin are widespread and the value of the presumptive test is diminished accordingly.

The answer to the above question would appear to depend upon the possibility of identifying with considerable accuracy those organisms: (a) Which are, in the majority of cases, indicative of excretal pollution; and (b) the absence of which from water indicates a safe degree of purity.

*Strep. faecalis* fulfils the first of these desiderata but, as previously shown, fails to fulfil the second.

*Clostridium welchii* fulfils the first, but the pollution may be so remote as to be of no immediate importance. As regards (b) the stormy fermentation test shows a reasonably close correlation with the *Bact. coli* content, but intestinal anaerobes are present in fæces, sewage and polluted water in fewer numbers than is *Bact. coli*, and a water containing the latter in 1 millilitre may not give a positive *Cl. welchii* test in 100 millilitres. For this reason failure to demonstrate the presence of *Cl. welchii* cannot be accepted as indicating the absence of recent pollution.

Members of the coliform group hold out the greatest promise, and a brief outline of the advances made towards their classification may not be out of place before an attempt is made to assess the extent to which they fulfil our demands.

### III.—THE CLASSIFICATION OF THE COLIFORM GROUP.

Escherich (1885), in his original description of *Bact. coli*, defined two types, *Bact. coli* and *Bact. lactis aerogenes*. Jordan (1890) described an

organism which he isolated from sewage and which differed from *Bact. lactis aerogenes* only in its ability to liquefy gelatin. Kruse (1894) added to these a number of types which, though related biochemically, were not typically inhabitants of the intestinal tract and which showed a wide distribution in nature. Subsequent investigation classified these into two main groups. The first fermented certain polysaccharides and gave a negative indole reaction. This group corresponded with the *Bact. lactis aerogenes* of Escherich and has now become *Bact. aerogenes*. The second group did not ferment starch and gave a positive indole reaction. The members of this group were later subdivided according to their reaction with saccharose. One, *Bact. coli commune*, did not ferment saccharose. Another did so and was named *Bact. coli communis* by Durham (1901).

The next observation of practical importance in the examination of water supplies was that of Winslow and Walker (1907) who found that *Bact. aerogenes* was widely distributed in the soil and on grasses, whereas *Bact. coli commune* and *Bact. coli communis* typically inhabited the intestine.

The group was subsequently further subdivided and various classifications were applied to it.

From the point of view of the examination of water supplies, it was desirable to subdivide the coli-aerogenes group into those organisms which are typically of intestinal origin and those which, though they may be found in the intestines possibly as the result of ingestion with foodstuffs, are widely distributed in Nature, and whose presence in water therefore does not necessarily indicate faecal pollution.

Endeavours to bring about this sub-division played an important part in the further systematic classification of the group, and many tests have been employed, firstly to separate organisms of the coliform group from all others, and, secondly, to subdivide the coliform group on the above basis. Of the latter tests, the following are the most important :—

The ratio of  $\text{CO}_2$  to  $\text{H}_2$  in the gas produced by fermentation of lactose had been found by Smith (1895) to be higher in the case of *Bact. aerogenes* than of *Bact. coli*. This finding was elaborated between 1901 and 1906 by Harden and others, who demonstrated that the coliform group could be divided into coli types, producing a  $\text{CO}_2 : \text{H}_2$  ratio approximating to 1 : 1, and aerogenes types, producing a ratio of approximately 2 : 1.

The indole test was introduced by Böbme (1906) and was considered when positive to give a definite indication of coli type, but this position is no longer tenable, as has been shown by many observers (Pawan 1931, Burke-Gaffney 1932, Bardsley 1934). The test, nevertheless, fills an important place in the classification of the coliform organisms and a high percentage of the strains isolated from mammalian faeces are indole positive.

Voges and Proskauer (1898) introduced the V.P. test and attention was later drawn to the fact that V.P. negative types predominated amongst strains derived from faeces.

Petruschky (1889) had endeavoured to estimate the degree of acidity produced by the various members of the group and this led to the introduction of the methyl-red test by Clark and Lubs (1915).

As a result of the introduction and elaboration of these tests it was found possible to divide the lactose-fermenting coliform bacilli into two subgroups.

The first subgroup contained strains producing gas with a  $\text{CO}_2 : \text{H}_2$  ratio approaching 2 : 1, V.P. + and M.R. - reactions. Included among these were the majority of the strains isolated from materials non-excretal in origin, in fact the *aerogenes-cloacæ* types.

The second subgroup contained strains producing gas with a  $\text{CO} : \text{H}_2$  ratio of about 1 : 1, V.P. - and M.R. + reactions. Included among these were the majority of strains isolated from mammalian excreta, i.e. the true coli types.

At the time, this appeared to be a satisfactory ecological classification of the coliform bacilli but the subsequent introduction of other tests proved that this was not the case.

Of these probably the most important was the citrate test. Brown (1921) found that the addition of citrate to the medium assisted in separating *Bact. aerogenes* from *Bact. coli*. This was applied by Koser (1923), who later introduced his medium in which citrate is the sole source of carbon. By this means he was able to divide the coliform organisms into those capable of utilizing citrate as a source of carbon and those not capable of so doing. It was thought that the citrate test might lead to a classification based on habitat but this belief also proved to be without foundation. Nevertheless the test led to a broad subdivision of the group into M.R. + V.P. - citrate - coli types; M.R. - V.P. + citrate + *aerogenes-cloacæ* types; and M.R. + V.P. - citrate + intermediate types.

As previously stated, Eijkman (1904) claimed that *Bact. coli* but not *Bact. aerogenes* would grow and produce gas when incubated in a special glucose medium at 46° C. Many investigators have since reported on this test and opinions regarding its reliability or otherwise are divided. The test has been thoroughly investigated recently in this country by Wilson *et al.* (1935), who attribute adverse criticism to incubation at temperatures other than the optimum. They found that 46° C., as originally proposed by Eijkman, is too high; consider the correct range to be 43° C. to 45° C.; emphasize that this must be the temperature of the medium and not of the incubator, and advise that this can be assured only by the use of a constant temperature water bath, adjusted to give the correct temperature in the medium. They produce ample evidence to the effect that gas production is better in MacConkey broth than in the Eijkman glucose broth as modified by Williams, Weaver and Scherago (1933) and conclude that there is no advantage in using the latter medium. They also conclude that "no other test is able by itself to pick out such a high proportion of faecal strains and no other test is more rapid in yielding its results."

IV.—DIFFERENTIATION OF THE COLIFORM GROUP ACCORDING TO HABITAT.

Topley and Wilson (1936) express the opinion that the primary subdivision of the lactose fermenters must be made on the basis of the gas ratio, M.R. and V.P. and citrate tests. They are less definite concerning their further subdivision, favouring systematic classification on the basis of sugar reactions, but accepting the indole, modified Eijkman and gelatin liquefaction tests for further ecological differentiation. The gelatin liquefaction test does little more than differentiate *Bact. cloacæ* from *Bact. aerogenes* and since the significance of these two organisms is the same it may well be omitted from routine water work. Many other differential tests have been introduced from time to time but the chief concern of the sanitarian is whether a coliform organism is or is not of fæcal origin, rather than whether or not it ferments this or that sugar. Judged by this standard the most important tests would appear to be included in the following table compiled by Wilson *et al.* (1935). It will be seen that liquefaction of gelatin is known to be of value only in differentiating *Bact. cloacæ* and two irregular types.

TABLE I.—CLASSIFICATION OF COLIFORM STRAINS.

	M.R.	V.P.	Citrate	Indole	Eijkman 44° C.	Gelatin lique- faction
<i>Bact. coli</i> type I .. .. .	+	—	—	+	+	—
„ type II .. .. .	+	—	—	—	—	—
Intermediate, type I .. .. .	+	—	+	—	—	—
„ type II .. .. .	+	—	+	+	—	—
<i>Bact. aerogenes</i> , type I .. .. .	—	+	+	—	—	—
„ type II .. .. .	—	+	+	+	—	—
<i>Bact. cloacæ</i> .. .. .	—	+	+	—	—	+
Irregular I, coli-like 1 .. .. .	+	—	—	+	—	—
Irregular II, coli-like 2 .. .. .	+	—	—	—	+	—
Irregular III, coli-like 3 .. .. .	+	—	—	—	—	+
Irregular IV, intermediate-like .. .. .	+	—	—	—	—	+
Irregular V, aerogenes-like 1 .. .. .	—	+	—	—	—	—
Irregular VI, aerogenes-like 2 .. .. .	—	+	+	—	+	—
Irregular VII .. .. .	—	—	+	+	—	—
Irregular VIII .. .. .	—	—	—	—	—	—

It will be seen that, in addition to the coli, aerogenes-cloacæ and intermediate subgroups, this table introduces a further eight types which the authors term irregular. The introduction of these appears further to complicate the situation from the point of view of the sanitarian who endeavours to form an opinion regarding the source of water in the limited time available before the supply must of necessity be brought into use or discarded as unsuitable. This is not actually the case since their work throws considerable light upon the usual sources of the types described. Its significance in this respect can be assessed by a study of Table II, also

extracted from their report, which shows the origin of the various strains classified in Table I.

TABLE II.—FREQUENCY DISTRIBUTION OF COLI-AEROGENES BACILLI IN DIFFERENT TYPES OF MATERIAL.

Type	Raw tank milk		Pasteurized milk		Cow dung		Foodstuffs	
	No. of strains	Per cent	No. of strains	Per cent	No. of strains	Per cent	No. of strains	Per cent
<i>Bact. coli</i> I .. .. .	39		17		114		10	
<i>Bact. coli</i> II .. .. .	29	30.2	2	41.3	2	98.4	6	32.6
Coli-like irregulars I, II, III..	6		0		7		10	
Intermediate I .. .. .	65		15		0		7	
Intermediate II .. .. .	10	31.8	0	32.6	0	0.0	0	11.2
Intermediate-like irregular IV	3		0		0		2	
<i>Bact. aerogenes</i> I .. .. .	66		6		2		25	
<i>Bact. aerogenes</i> II .. .. .	13	33.8	1	17.4	0	1.6	0	31.2
<i>Aerogenes</i> -like irregulars V and VI	4		1		0		0	
<i>Bact. cloacæ</i> .. .. .	9	3.7	3	6.5	0	0.0	19	23.8
Irregulars VII and VIII ..	1	0.4	1	2.2	0	0.0	1	1.2
Total .. .. .	245	99.9	46	100.0	125	100.0	80	100.0

From the above table it will be seen that of 125 strains of known mammalian intestinal origin, 114 belonged to *Bact. coli*, type I. The number of *Bact. coli*, type II, isolated from the same source, showed no marked predominance over aerogenes. Since this last organism is accepted as being typically non-fæcal in origin the evidence suggests that *Bact. coli*, type II, is also merely an accidental inhabitant of the intestine.

Only one strain of irregular III was isolated and that from ground-nut cake. It cannot, therefore, be considered to be of fæcal origin.

Coli-like irregulars I and II come into a rather different category. Of 22 strains isolated 7 (32 per cent) were derived from dung and the authors suggest that these may be natural inhabitants of the intestine. In view of the fact that 63 per cent of the fæcal coli type I isolated were derived from dung this suggestion must be considered tentative and it would appear to be at present impossible to assess their precise significance which, in view of their comparative rarity, is of little importance in routine water analysis. There is no evidence which favours a belief that any of the other types may be typically fæcal in origin.

It would be of considerable interest to know whether *Bact. coli*, type I, also was isolated from the samples from which other types were derived. This would appear probable since the 125 strains studied were derived from only 50 samples of dung.

Bardsley (1934) studied 5,181 strains of coliform bacilli derived from

water, soil, fæces, and ice cream. They were classified by the M.R., V.P., citrate, uric acid, and indole tests. The investigation was carried out before the modification of the Eijkman test, which was therefore not included. It threw considerable light on the occurrence of typical *Bact. coli*, defined as M.R. +, V.P. -, indole +, uric acid -, citrate -.

Two hundred and twenty strains were isolated by plating on MacConkey agar an emulsion of fæces in peptone water. Selected colonies, usually five in number from each plate, were subjected to further tests.

Of thirty-two samples of fæces examined by this method, thirty yielded a typical *Bact. coli*. The failure to recover typical coli from only two plates might well have been due to the chances of selection of colonies.

There appears to be some difference of authoritative opinion as to whether *Bact. coli*, type II, should or should not be regarded as typically faecal in origin and therefore indicative of recent dangerous pollution. In a classification of the coliform bacilli in relation to their habitat, Topley and Wilson (1936) describe the probable source of this type as non-excretal and consider that *Bact. coli* type I is apparently the only coliform organism that finds its natural habitat in the mammalian intestine. Wilson *et al.* (1935) say of type II: "This organism is infrequent in human and bovine fæces and in pasteurized milk. It appears to be quite common in raw milk and on hay and straw. In our series its frequency in cow dung was no greater than that of *aerogenes*, both forming less than 2 per cent of the total strains isolated. It is impossible to say what the real significance of this organism is, but it seems doubtful whether its presence in milk should be ascribed to excretal contamination."

Their report later refers to non-faecal coli (coli II).

Ministry of Health Report (1936), on the other hand, refers to "*Bact. coli* faecal type II." No evidence in support of this description is produced. The bulk of the available evidence strongly supports the supposition that *Bact. coli* type II is typically non-faecal in origin; it may, however, as is the case with *aerogenes* and intermediates, be found in small numbers in the mammalian intestine possibly as the result of ingestion with foodstuffs.

The present situation is, therefore, that *Bact. coli* type I is typically faecal in origin; that coli-like irregulars I and II may or may not be faecal, and that all other known members of the group are typically non-faecal.

Muir and Ritchie (1932) consider that the term "*typical Bact. coli*" may be used to designate those types which are most prevalent in the intestine, and therefore undoubted indicators in water of recent sewage pollution. If this be accepted the term should be restricted to *Bact. coli* type I.

Many observers (Pawan, 1931; Burke-Gaffney, 1932; Bardsley, 1934) have shown that *Bact. aerogenes* is present in mammalian fæces in small numbers only. It has, on the other hand, been shown to be a common inhabitant of infected urine, in which it may exceed *Bact. coli* in numbers (Hill, *et al.*, 1929; Burke-Gaffney, 1933). It cannot, therefore, be altogether

disregarded as an indicator of excretal pollution, although its correct significance as such requires careful assessment. Bacteria of the typhoid group, when present in urine, may be unaccompanied by coliform organisms, and their introduction into a water supply could not in these circumstances be detected by any coliform test. That *Bact. aerogenes* should be considered an indicator of recent pollution on the unlikely assumption that it might have been derived from infected urine is not suggested by Burke-Gaffney. On the other hand, he has suggested that the presence of aerogenes in the absence of faecal coli might be regarded as evidence of satisfactory purification.

Thresh (1933) has found that aerogenes can exist in water for long periods and may multiply in water. This has also been the experience of others.

Ministry of Health Report (1936) states, "Deductions already fairly well established are that (1) the presence of faecal coli is indicative of recent excretal pollution, since the majority of faecal coli die out within two or three weeks; and (2) the presence of aerogenes in the absence of faecal coli is much less reliable evidence of such pollution." It might with safety have gone so far as to say that the presence of aerogenes in the absence of faecal coli is evidence that any pollution which may have existed is so remote as to be harmless.

Clemesha (1912A) noted that diminished pollution in the water of the Red Hills Lake, Madras, brought about a marked increase in *Bact. aerogenes* which had been absent or rare during periods of heavy pollution.

Gray (1932) found that, in water contaminated by faeces, the aerogenes-coli ratio is relatively low, but that this is rapidly reversed by storage. He also found that in the municipal water supply of Liverpool the proportion of aerogenes to coli is relatively high and increases with storage. He concludes that a preponderance of aerogenes over coli in a water supply is indicative (1) of contact with soil not contaminated by fresh faeces, or (2) of long-past faecal contamination. He further concludes that a preponderance of aerogenes over coli in a water supply may, for practical purposes be regarded as an indication of freedom of the water from pathogenic organisms. This is strong meat to those brought up in the old tradition but there exists much evidence in support of this conclusion.

#### V.—DISCUSSION IN THE LIGHT OF PRESENT KNOWLEDGE.

The precise significance which may be attached to the presence in water of any one of the coliform group, with the exception of *Bact. coli* type I, therefore remains a matter of opinion. Furthermore, if the wide distribution of the majority of strains is borne in mind, it would appear that anything approaching a final answer is unlikely to be achieved. In tropical countries they frequently have little or no significance. The one outstanding fact is that, while other strains may or may not be present in faeces, this is the normal habitat of *Bact. coli* type I, which is comparatively

rare in other situations, whereas the remaining types have a wide distribution and occur in *fæces* in comparatively small numbers.

In the vast majority of cases investigation has been directed towards ascertaining whether this or that member of the coliform group may be found in excreta and if so, with what frequency. If found in a moderate proportion of cases it has been suggested that it should be regarded as indicating *fæcal* pollution. This appears to be no more logical than would the application of the same assumption to the finding of a plum-stone in a lake. Each may be *fæcal* in origin; each outlives the intestinal pathogens. The direction of investigation into this channel may have resulted from the influence of the "presumptive coli" test, to which all organisms of the coliform group give a positive result, and upon which great reliance has been placed for many years. Increasing knowledge has cast doubt upon its serviceability and a narrowing of the field has been sought by attempting to ascertain and discard those members of the group which may not be *fæcal* in origin.

A more practical approach to the subject would appear to be, not whether this or that organism may or may not be present in excreta, but

(I) Whether any one easily recoverable organism is constantly present, either alone or in conjunction with others, and

(II) Whether such an organism, if found, outlives the intestinal pathogens in an unfavourable environment.

If the answer to both these problems is in the affirmative, the selected organism would, of necessity, be present in a water containing dangerous *fæcal* pollution and should prove to be a suitable indicator of such pollution.

*(To be continued.)*

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# “BAJILLED.”

By AL GEBELI.

## I.

A FEW years ago I was having tea in a country house after an energetic game of tennis. I was much over-heated, but my flushed countenance was taking on an even deeper and more florid hue because of the close attention it was receiving from a middle-aged female on my right front. I felt most uncomfortable; and thought of all the places I could have met her but I could discover no niche into which the lady would fit. A masterful wife within easy reach of my left ear nevertheless kept me nervously anxious.

There was a lull in the chatter round the table and the stranger chose that moment to speak. “I have been wondering all the afternoon where I have met you,” which was exactly what I had been doing myself these last minutes. “It was in Aden in 1919, when the Armistice (peace with Turks in the Yemen was established later than elsewhere) was being celebrated in the Club at Steamer Point, I saw you dressed in a kilt and sporran dancing the Highland Fling on the top of a three-legged tea-poy, the legs of which were being supported by three senior officers of the Field Force. We all wondered how you kept to the table after having dined so well.”

It was on that memorable Armistice night when the revels had proceeded apace and when good champagne was quaffed in copious measure that I was enrolled as a member of a political mission shortly to proceed to Sana, the seat of the Imâm Yahya, amidst the lofty peaks of the Yemen Highlands in Southern Arabia.

The War had left me unscathed with very little to my credit. I was never one to seek danger when it could be avoided, and what on earth persuaded me to go and sign on on such a risky ploy I have never been quite able to say.

It is a long time ago, getting on for twenty years, and my memory, always faulty, has not improved of late, so I must be excused if I colour the story I am about to tell perhaps a little too brightly. There are two persons who alone can say whether it is too colourful or not bright enough.

The Mission to which I had pledged my service as Transport Officer was composed of men accustomed to dare. They were now about to dare the mountain passes, to scale rugged heights and to breathe the rich air of 7,000 feet which no occidental had done except it were his last.

Our chief "The Mandub" carried a name well known and honoured throughout the history of the Indian Army. He, good man, has lately gone to his God. Peace be with him. A pious kind soul to whom Arabia was paradise and the Arab his son. This partiality for the Arab had been the cause of much misunderstanding between him as chief political adviser and us soldiers during the small war which had engaged us for some four years. He was a fanatic, but his was not altogether a blind faith. No one knew the Yemeni better, no Moslem could excel him in his knowledge of the Koran or in the classical Arabic in which it was written. He was a man who earned something more than friendship from those who knew him well. "The Mandub" was our leader to whom we never failed in our loyalty.

The second in command, also a political officer, has risen high in his Service. He is so high that I must not say much about him. What I can say is that he fully earned every part of his success, and that in spite of it he remains the same genial unspoilt person we knew these many years ago. Let us call him for the want of a better name "Pop."

We draw nearer home when we come to the third member, a fair-haired giant in the Royal Army Medical Corps, whom we affectionately addressed as Ginger B. I am not writing confidentials on brother officers and I will leave readers to form their own opinion of him from what I am about to tell you.

Then there was "Yours Truly," and finally "Neda," an Indian political officer of Persian origin and a very devout Moslem.

We had an escort of twenty-five sowars of the Aden Troop commanded by Risaldar-Major Malikdad Khan, a fine old man close on his seventies, who could still take his pegs with lance or sword and beat the best. In addition we had eighty-one mules and fifty camels for riding and transport.

I received orders before the Mission left Aden to proceed to the Kameran Islands to inquire into a curious epidemic which had broken out amongst the Turkish prisoners incarcerated there.

The journey thence began on August 9 in the good ship "Kishna," which on leaving Aden Harbour began to be jostled by the seas so effectively and so persistently that it was not long before I was forced to assume a horizontal posture and, incidentally, to keep a careful watch for the first symptoms of an impending and inevitable gastric crisis.

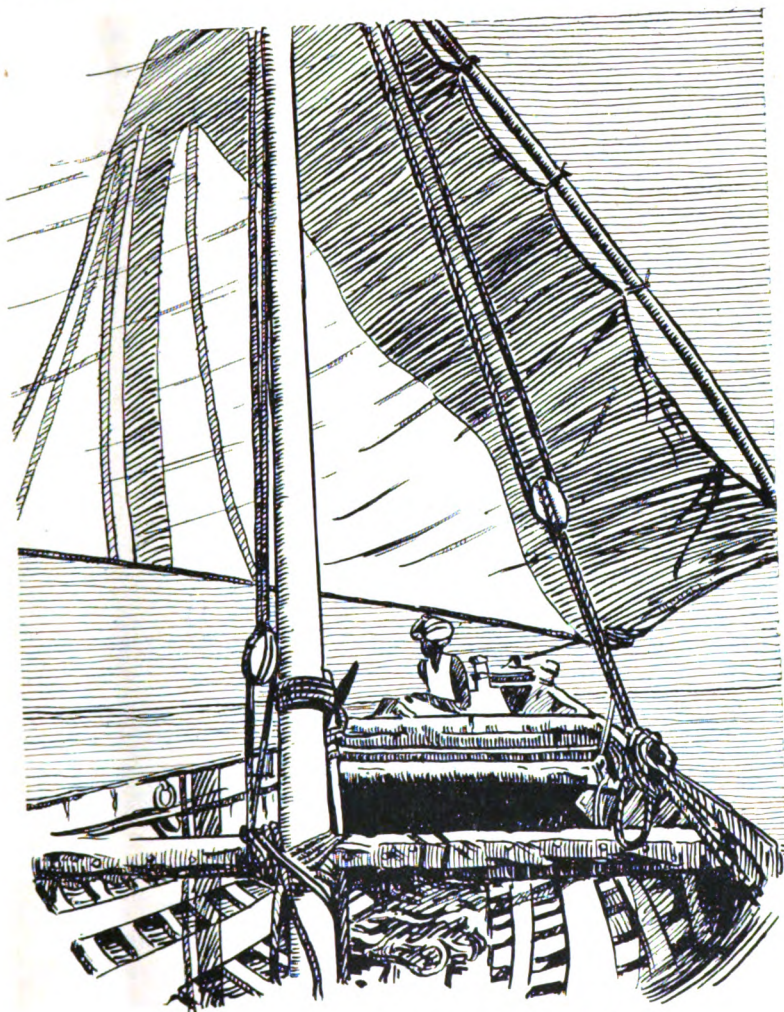
Kameran was reached and I was pushed ashore. On this barren island stands a lazarette for pilgrims on their way to Mecca. At that time it was run by a Greek doctor. We had there a company of an Indian regiment billeted in chappar huts, and I was conducted by an officer of the Indian Medical Service and the young Company Commander to inspect the

prisoners. It did not require much knowledge to diagnose that the epidemic was due to a food deficiency, and I plumped for scurvy. Careful inquiries elicited the fact that the Indian representative of the Supply and Transport was feathering his nest or fattening his tummy—always a sure sign that the Indian has sources of income other than his salary—by selling the richer portions of the prisoner's diet to the starving Arab population. A report to this effect was sent back to Aden and the offender was recalled and a cargo of fresh limes sent in his place.

My next business was to get from Kameran to Hodeida, where I was to meet the rest of the Mission. I found the only hope of accomplishing this was by hiring an Arab dhow, which I perforce did, a great bulk of a boat with the ribs of her bare to the heavens and not a square foot of shelter from stem to stern. The journey was scheduled to take six hours if a favourable breeze was blowing, and as I wanted to miss the experience of the Red Sea at midday in August, I arranged to leave at “screigh o’ dawn.” Sure enough the next morning when I stumbled in the dark to where the boats were moored I found mine ready to take the open sea. For a crew I had three wild-looking Arabs who bore a somewhat wilder look before we were finished with the trip. To sustain me on the voyage I took two hard-boiled eggs and a bottle of water.

When out in the deep sea we skelped along with a wind abaft the beam and it was a great pleasure to have the cool morning air about one's “lugs,” and to see the dawn creeping up over the horizon of the Red Sea. And so we proceeded until Allah, convinced we had reached a point at which the fullest force of the sun's radiant heat could take its greatest effect, withdrew the breeze and left us in a dead calm, just the sort one hopes for in the Bay of Biscay when one is beating it home to Southampton from the Far East; but the last thing one wants in a dhow in the Red Sea in the hottest month of the year. I got as comfortable as the belly of the boat would allow and prepared to await the coming of the breeze which never came. The heat became intolerable, and by the time the evening arrived I had begun to feel the effects of dehydration and was in a bad way. I had long since finished my two eggs and the bottle of water, was very thirsty, and had a terrific headache. The heavy swell had rocked us about, and all day long every mast, spar and beam of the dhow had creaked and groaned. It was a fitful night that I passed, without comfort or sleep, and queer ideas kept passing through my noddle. I could see the Arabs lying along the gun-whale motionless, accepting without complaint the Will of Allah. I worked out the patterns the stars made in the heavens as a sick man does with wallpaper. Dawn saw us to all intents and purposes in the same spot, the sea as smooth as ever. As the hours passed and the heat increased I began to realize that I must fight with all my power the growing desire to give way. I remember watching a shoal of large gar-fish sporting

themselves on the surface of the water. The recollection of them comes hazily to my mind. I seemed to see a thousand walking sticks lashing the sea and then skimming vertically for hundreds of yards. I have since been told this is the habit of these fish, so it must have happened. Then some miles distant I observed what appeared to be a gigantic lobster claw



The wind dropped and we were left in a dead calm.

raising itself some fifty feet into the air and opening and closing. I remember arguing with myself, but to argue was extremely wearisome. The phenomenon continued without a pause, and watching it I drowsed sleepily, and when next I became conscious it had come close up to us. I was clear witted enough to realize it was an enormous fish of the shark

tribe, and the clippers I had seen were the dorsal fins slowly revolving as the monster fish pushed forward. It was late in the afternoon when one of the Arabs shook me, and saying, “Howa yegi,” wind is coming, pointed to a darkening band on our starboard side. The knowledge had a most stimulating effect on me. I could just manage to stand up and peer over the gunwhale, so very weak was I. We were soon spanking along, and by 9 p.m. we had come opposite to the shore at a point called Ras al Katib. The water was intensely phosphorescent, the waves on the distant sands breaking in lines of incandescent white, and when I looked down into the depths I saw big and small fish moving about like lanterns; occasionally one would leap like a flaming torch into the air or a shoal of sardine fry chivvied by some larger fish would spray the surface with fire.



Hodeida.

At 2 p.m., very nearly forty-eight hours after setting sail from Kameran I arrived at Hodeida. It was pitch dark and the Arabs carried me to the British Consul's house. The Consul was most kind, giving me all the attention I so much needed; a bed on which to rest my weary body was not the least welcome, and once there I slept the clock round.

The mission, consisting of the four British officers, the Indian Political Officer, the Risaldar-Major, two Indian N.C.O.s and twenty-five sowars, arrived on August 18.

It would be well to state here the object of the Mission, but at this stage of our journey I had no inkling of our reasons for visiting Imām Yahya. In the Moslem faith there are two main factions, the Sunnis

and the Shias, with the same intolerant hatred for one another as Papist and Protestant had in days gone by.

The Shias in this part of the Mohammedan world hold that the Imâm is not only the temporal ruler, but from the fact of his being a descendant of the Prophet he is recognized as their spiritual head. The Sunnis recognize no divine right of succession and ignore his relationship with Mohammed. The fact that the Imâm lives and rules over the mountainous districts of the Yemen means that these regions were the main Shia stronghold, while the littoral plain, which averages some fifty miles in depth, is populated by the Sunnis.

Sana, the Imâm's capital, had been the Turkish Headquarters during the war. The Turkish Army evacuated the Yemen after the Armistice, and it was thought to be an opportune moment to inquire just what was the feeling of the Arab tribes uninfluenced by Ottoman domination.

The Yemen Highlands are rich in metals, raw materials and hides. The Imâm owned no seaport and had no corridor through which he could transport his exports without heavy taxation, which you may be sure was amply imposed. We were directing our steps to the distant hills to offer him the port of Hodeida and a communicating road as our contribution to the pact which we hoped to make with him.

You may well imagine the joy the news of these intentions would have on the Arab tribes who now occupied, if they did not actually own, the coveted areas! I do not know whether the matter was kept strictly secret, but with even my limited knowledge of the Arab and the extraordinary speed with which the most confidential affairs spread, there is little doubt but that the Sunni tribes all along the littoral were apprised of our intentions.

We had definite evidence of this within a few days of our arrival at Hodeida. Warning messages had come to the ears of the British Consul that treachery was afoot. He, however, pooh-poohed the suggestion. Had not two of the most influential Sheikhs of the lands through which we were to proceed come to Hodeida to give us safe escort? Once the oath sworn on the Koran for this conduct was given no Arab, if he hoped to reach the Seventh Heaven, would ever think of breaking it. And so agreed the head of the mission.

The itinerary of the journey had been prepared by the Consul, stage by stage: Tanam, Bajil, Obal, Hajeila, Wasil, Menakha and so on to Sana, each at roughly twenty miles interval from the other. From Obal, which lay at the base of the foot-hills, the tract was described as traversing the most magnificent scenery, creeping slowly and circuitously up and upwards to a height of 7,000 feet, with monstrous chasms, giddy rock faces, and always and everywhere clear mountain rills and freshets. The Eurasian Consul had apparently let his poetic imagination run riot pretty



freely, and it was no wonder that we were eager to get on the move. Cool upland breezes and these clear mountain freshets were temptingly attractive after the humid heat and squalor of Hodeida.

Two circumstances had adversely affected this seaport town, one the bombardment by our Red Sea Patrol, which had fired the wattle huts—arishes—and left a black desolation on its southern aspect, and the other the blockade which had deprived the community of the main source of its food supply, namely that which is imported from Aden.

Starving Arabs were everywhere, children were mere skin and bone, a condition which compared ill with the corpulent anatomy of our friend the Consul, who, presumably, was not ignorant of the famine around him.

## II.

The transport under Duffadar Moh'd Shah left on August 19, and the Mission with the first line transport on the day following at 4.45 p.m. Each of us was mounted on a mule, which is not a very striking animal to ride upon, and the state procession through the town lost a considerable amount of dignity thereby. The Officer Commanding the 7th Rajputs, who were in camp to the north of the town, and the Consul accompanied us. When we were clear of the Bab-al-Mushrif, the city gate, we broke into a canter which rendered us still less dignified, as the majority had no control whatsoever over their beasts, some of us not having thrown a leg across any kind of saddle for a considerable time. I was in the rear and I well remember the look on the face of the mule which carried the portly figure of the Consul. The quadruped was enjoying it to a superlative degree, and had the situation completely in hand. The Consul's puttees had become unwound and streamed like pennants behind, while he must assuredly have required soothing ointment to his hinder-end before retiring for the night. Abu Hade and Baghawi, the two Sheikhs who had come to escort us, both belonged to the Kuhra tribe and preceded the cavalcade on Arab “Tats,” each with a bodyguard of half a dozen men. Round the perimeter of the town were a number of picquets, and when we arrived at the post which guarded the road into the town a halt was called and a farewell taken of the Commanding Officer and the Consul. Then we turned our mules towards the hills and the East and commenced the slow wearying trek across the sandy desert.

As the evening darkened ominous rumblings could be heard in the distance and lightning flashed continuously, showing up the outline of the mountains in silhouette like the teeth of a giant crocodile. So we progressed in “pit mirk,” our Mandub, with whom I rode, complaining repeatedly of his mule walking backwards, a phenomenon which, when he pointed it out to me, appeared to be definitely a fact, but which was no more than an optical illusion. At 8.30 p.m. we arrived at Tanam and

took up our quarters in an Arab coffee house where we partook of Bun (coffee) and rested our weary bones on bug-infested charpoys. At 11.30 p.m. an unpleasant and disturbing noise of human origin and of rapidly increasing volume woke me from a delightful drowse which had been induced by the manipulation of my fatigued muscles by a professional Arab masseur, than whom there are none in the world more adept. It was not long before I recognized some well-known expressions and the author of them, and when I found Ginger B. standing over the charpoy in a threatening attitude, I realized that I was the person whom all this pother concerned. I was being told that I was the — Transport Officer and being such I should have attended to my duties, instead of which I left it to him to bring in the transport and he had had the most damnable time replacing loads which kept falling off, resulting in his arrival three hours after us. I felt humiliated and extremely guilty, but Ginger B.'s good nature and a glass of something strong were responsible for rapidly terminating the strained relationship between us.

After a meal and a night cap we pulled our beds outside and slept under the dome of a starry heaven.

The journey was not continued until the afternoon of the next day. Punctilious to my promises of the previous night I collected the transport at 2 p.m. and with Sheikh Baghawi as guide started on the second and what turned out to be the last stage of our journey. The remainder of the party caught us up at Dar Ahmed within three miles of Bajil, by which time it was dark. Our course lay up the bed of a wadi, possessing steep banks and many irregularities which continually crossed our track and led to first the Mandub taking an imperial toss, followed by our sweeper, who struck earth so forcibly that he was completely winded. I had dismounted and was walking to take the stiffness out of my limbs when word came back that treachery was afoot and to be prepared to take the necessary precautionary measures, i.e. to load the Webley-Fosbery revolver. The presence of large numbers of Arabs hovering like vultures round us could be sensed rather than seen. We halted and closed in together so as to make our stand should an attack eventuate. But nothing happened and we moved on again. It was not long before we were passing between the wattle huts of Bajil and being led to a large square white building, the Turkish Custom House, on the flat roof of which we were shown our quarters. It was very dark, and owing to the paucity of lamps considerable difficulty was experienced in assembling the kit, and it was 12 p.m. before we had settled down for the night, and what an infernally hot night it was. The Mandub collapsed, Neda had a colic and the rest of us felt pretty cheap. I think the suspicion that some danger threatened us had lowered somewhat our morale.

If the night was hot the days that followed were much hotter, for

as will be seen we were forced to take a halt, and our accommodation did not help matters as we were crushed into a room ten feet by ten with only slats of wood for the roof to shelter us from the gruelling mid-day sun. On the second day Pop began to show signs of distress and finished up by going completely out for a count of fifteen minutes, while Ginger B. and I laboured to bring him to his senses. On the adjacent camp-bed the Mandub was also wrestling with an impending heat stroke, the temperature rising ominously. Between the two of them we were kept busy. Neda was laid flat and Ginger B. and I had dreadful headaches and to have to face a critical situation with us all in this state was a bit hard. The danger of death by heat stroke, however, completely overshadowed the risk we ran in being where we were.

It was not long before we were informed that we must consider ourselves prisoners and that all idea of pursuing our journey to Sana or withdrawing to Hodeida must be dismissed entirely from our minds. We were "stay put" for good or for evil, and since the remainder of this story will have the same dreary background let me describe it now. Our quarters, as I have stated, were on the roof of a two-storied building which stood in the middle of a village of "arishes." On the south side in close proximity stood the ruins of a fort which was now used as the local prison. A few low hills partly encircled us on this side, and at some ten miles distant the great mountains rose tier upon tier. Two bold massifs, Milhan and Burha, stood guard on each side of the track which leads up from Obal to Sana. One could see the terraced fields extending to an altitude of 5,000 feet and here and there clusters of houses where the wild gebelis lived. Stone dykes retained the strips of fields which provided sufficient millet for the needs of the highlanders. Every grain of earth had been carried from the plains and the terraces were so constructed that there was little risk of torrents scouring the fields and washing the precious soil back into the valley.

The actual country between us and the hills was either hard putt ground sparsely covered with camel thorn, and fields.

On the roof, which was bordered by a five foot coping, were four small rooms. One, that already referred to, of small dimensions and having a solitary window; another of similar size but without a window which was used as the bathroom; and between these a covered shed open all along the front, in the rafters of which myriads of bats lived and showered us with their droppings. The last enclosure was quite a small chamber which might be described as a sanitary annex. It was not misappropriated by us but must have been used for the same purpose for centuries; the night soil deposited on the floor was pushed through a hole in the wall from the outside of which a pyramid of sludge reached to roof level, a ghastly sight if one was rash enough to peer over the parapet and view it.

At first we were allowed out with a guard of armed slaves. We never

quite knew whether the guard was to prevent us bolting or to preserve us from being kidnapped by other Sheikhs. I believe it was for both reasons. Then for a time we were forced to keep to our quarters and later, according to how the situation eased or grew difficult, our freedom to wander about varied.

I have already introduced two Sheikhs, namely Abu Hade and Baghawi: Abu Hade was chief of the Kuhra tribe in whose hands we happened to be, and was by far the most cultured of any of the others with whom we came



Sheikhs of the Kuhra Tribe.

in contact, and there is no doubt but that we owe him our lives. He was never ruffled and though this imperturbable calmness was at times most irritating, it certainly had the effect of damping the murderous zeal of his associates.

Baghawi, who with Abu Hade accompanied us from Hodeida, was a sleek, slippery-fingered gentleman who owned land near the coast and who was a hirer of camels. He was the most variable of any in his attitude to us; sometimes ready to crack a joke, at other times frowning on us, but

mostly in a hot temper when his voice would rise threateningly and his hand would seek his gambia (dagger). Money was his god and he knew we carried treasure with us. But the real stumbling block to our further progress was a black-avised villain called Mohammed Zaid who was feared by all and sundry. He loathed us with all the hatred that a fanatical Moslem could cultivate for the Christian infidel. That we did not suffer sudden and hideous deaths was not his fault. He held the land in the neighbourhood of Obal, the next halt had our journey fructuated.

Then there was the malignant Kussam. I really do not know from whence he came, but I do know that his “coming” did not help to make things easier for us.

The last of the local Sheikhs was Yahia Ali, a hoary haired and bearded veteran whose bark, loud and vociferous was, I think, worse than his bite. He would have none of us and was for ever blasting us to perdition.

These were the shepherds into whose safe keeping such gentle lambs as we had fallen, yet there was one other *dramatis persona*, who, though not a Sheikh, had enormous influence over the others. This was Abdul Kadar the Saiyid or Holy Man. He lived within earshot of our roof-dwelling, yet most of us only saw him on one occasion during Id returning from the mosque and receiving as he came the worshipful knee-kiss of the tribesmen. It was at the “arish” of Abdul Kadar, whom I shall in future refer to as the Holy Man, that all the conferences and intrigues between the Sheikhs took place. These were continued long into the night with much loud argument; the longer they lasted the wilder became the talk and the more boisterous the behaviour. The Arabs in these parts eat the raw leaves of a shrub called kat which grows on the hillsides. The leaves have a flavour not unlike the young shoots of the hawthorn. The Sheikhs only eat the more delicate leaves while the coarser are thrown to and devoured ravenously by their slaves. The effect is an intoxication, the eyes have a drunken blood-shot look, the speech is thick and slurred while the consumer becomes more and more excited, soon losing his self-control. Its effects are more or less like hashish and under its influence dirty deeds are liable to happen on dark nights. The habitual kat-eater sooner or later begins to suffer deterioration, and it is a common occurrence to meet these moral wrecks throughout the Yemen. When we heard the Sheikhs’ voices rising at midnight and knew that at this bewitching hour the kat was having its full effects, it was no pleasant thought to know that the topic of conversation concerned ourselves.

The Imâm had sent a mounted escort to Hodeida and these swarthy bearded Zeidis, as the highlanders are called, remained in Bajil to represent Yahia’s authority. He had also sent a representative to Bajil to welcome us, one Ali Salami, a dreary voiceless creature of whom no one took the least notice. The fact that he was an envoy of the mighty ruler of the hills did not appear to carry any weight whatsoever with the local sheikhs.

The Zeidi soldiers were most picturesque. They wore a lungi more or less knee high with bare legs and sandals, sheep skin poshteens and navy-blue mashedas. They always kept together, generally in line linked arm and arm, holding to the key of the causeway and singing a queer yodelling chant at the top of their voices. We were continually being entertained with the melody and could produce it ourselves if encouraged. They kept aloof from the local Arabs, finding sufficient entertainment apparently among themselves; once or twice they would take to dancing their war dance at night



One of the Imâm's Zeidi soldiers.

round a fire on the ground below our house. It was a sight the like of which might well have been seen in many a Scottish glen in the days when dirk and broadsword were of greater moment than pounds, shillings and pence. Like the Strathspey eight men took part, facing inwards to the fire round which they had taken their places and moving in and out with naked gambias flourished in the air while the spectators kept up a wild chant to the accompaniment of tom-toms. The fire lit up the dark bearded faces and made the shining daggers flash like lightning.

These were the surroundings and these the personalities with whom the story is concerned.

*(To be continued.)*

## TROOPS IN THE FEN FLOODS.

BY MAJOR C. BOOTH-JONES,  
*Royal Army Medical Corps, T.A.*

THE state of emergency which arose from the floods in the Fen Area necessitated the employment of troops, technical and otherwise, who reinforced the local labour available, and provided skilled help where especially required. This undertaking meant the collection of personnel, stores, transport and supplies, and their despatch to the Area almost at a moment's notice.

When the call for help came a few signal details of the Royal Air Force were already posted with wireless sets at some of the danger points, but as the situation became more threatening further assistance was urgently needed, and troops, transport, etc., were detailed and sent off approximately within twenty-four hours, converging on Ely as headquarters.

The formation, distribution and general arrangements of this "Fen Force" constituted a problem allied to a "tactical exercise," and a few notes from the general, and more particularly the Medical Services, point of view, may be of interest.

The situation in the flood area may be summed up in a few words, as follows :—

Most of the "danger points" lay along the Bedford rivers, old and new, with Welney Wash lying between them, a flooded area about fourteen miles long, the flood extending in places to the low-lying tillage land on each side, particularly near Littleport.

The Ouse River and some of the larger feeders, such as Soham Lode, "Seventeen-Foot Drain" and others were also threatening to burst their banks, anywhere, at any moment. If this had happened an enormous extent of land, with farms, cottages, villages and roads would have been quickly flooded to a depth of perhaps ten feet or more. This threatened area was large and scattered, and, owing to flooded roads, access to many points meant a long detour. Everywhere the ground was water-logged and muddy, rendering movement or transport difficult.

To deal with this "tactical situation," a plan was drawn up under three main headings arranging for: (1) Evacuation of civil population, in conjunction with local police and county authorities, centres for refugees being organized and set up in Ely; (2) patrolling of river banks and other danger points; (3) repair and reinforcement of banks, dams, etc.

These plans were put into operation as quickly as possible.

The troops employed consisted of details of the following Units located at three principal points :—

Headquarters, Ely (Chief Constable's Office) :—

Staff-Captain with Assistant Officer.

A Medical Officer, an R.A.S.C. Officer, Clerks and Dispatch Riders.

Royal Corps of Signals (two companies) with wireless equipment.  
R.A.S.C. Transport. Cavalry with lorries.  
R.A.O.C. workshop and repair section.  
R.A.M.C., one Other Rank with Ambulance.  
R.A.M.C. one N.C.O. (Sanitary).

At Welney :—

Infantry of the Line (Depot Suffolk Regiment).  
Royal Artillery, with Field Telephone Equipment.  
Royal Engineers, Field Company with Pontoon Section.  
R.A.M.C. (one N.C.O.) with equipment.

At Upwell :—

Royal Engineers—Field Company.

The "Defence Scheme" was carried out in this way :—

(1) A pool of transport was formed in Ely, available at a moment's notice.

(2) The Royal Corps of Signals established a chain of stations along the rivers and at other points. Each post had a No. 1 Wireless Set. The Royal Artillery set up a telephone station at Welney, sent out patrols, and laid field telephone lines to various points, nearly thirty miles in all.

(3) Fatigue parties worked in relays at the repair of banks, etc.

By nightfall on March 25 it could be said that the Defence Scheme was in full swing. Signal communications had been established over the whole area; any point where patrols were could get in touch with Headquarters in Ely, where the Royal Corps of Signals had a receiving station, and the Civil Engineers of the Catchment Board were in direct touch with the Staff.

It was a remarkable achievement in the time available, and brought out most forcibly the enormous advantage of modern mechanical transport. In addition to the quick collection and distribution of the troops, it was noteworthy with what ease the rationing and supplies were carried out daily over the whole area. Each unit was responsible for feeding its own isolated posts, in some cases sixteen miles away, and the work was carried out without a hitch.

The actual number of troops over the period of about nine days averaged 230 other ranks with 14 officers; the highest number on any one day was 305. As these details and stores were drawn from Aldershot, Chatham, Canterbury, Colchester and Bury-St.-Edmunds, the staff work was complicated and heavy for such a small (total) Force.

The problem of accommodation was complicated by the nature and conformation of the area, and in some respects was reminiscent of the Great War. Approximately 45 per cent of the men were billeted (some with subsistence, some without) in hotels and private houses. The remainder were located as follows :—

In Ely, a central camp and lorry park were set out. For this purpose the Territorial hall and field immediately adjoining were most useful. The



hall and recreation room with a rifle range gave accommodation under cover, although at first there was some overcrowding. This camp, after a few days, became highly organized, with proper washing facilities and cooking, and could have been successfully worked for a much longer time.

At Welney the conditions were almost war-like. Welney village consists of a long narrow main street on the main road between Upwell and Littleport. At the east end of the village the road crosses a bridge, and at this time it finished there in the floods. The scene from this bridge was extraordinary; a huge inland sea lay to right and left as far as one could see; trees, telephone poles and hedges stood up mournfully, literally struggling to keep their heads above water, and with a dull threatening sky overhead, a cold wind carrying an occasional scurry of snow, and the view of this muddy-coloured flood, the whole prospect was as depressing and un-English as one could imagine. The village itself was strangely reminiscent of many billeting villages in France. On each side of the "street" are small houses, mostly of the cottage type, separated from the road by a deep ditch, running bank-high. In between houses are chicken-runs, small middens, farm yards and lumber of various sorts. At the back, the dead, flat fen-land was waterlogged and marshy. It was indeed a problem to find accommodation for troops. However, with the goodwill of the local inhabitants, some men were billeted and the remainder occupied the parish hall, a school, and finally some rooms in the alms houses. An Aid Post with a R.A.M.C. N.C.O. was established here. Fire-places were available in all these places, and unlimited fuel was supplied. This was of importance as the weather was wet and cold, and drying clothes was necessary at all times.

At this point it has to be said that the Medical Services on this occasion had no previous information of any sort; the numbers of troops, the plan and purpose were unknown, and no opportunity for any preliminary survey was given. The troops had been hurriedly despatched, arriving at intervals, and a fair number had been in Ely for two days before a medical officer, who had been hastily rushed off with an ambulance and equipment, arrived. Thus one might say our work started three days late, and this proved a handicap to the organizing of the medical side, and the procuring of necessary stores. On arrival in the area the first necessity was a medical reconnaissance of the whole position and this was carried out forthwith. (Involving, incidentally, a mileage of ninety-seven).

The Central Camp in Ely was the starting point. Here troops had been in occupation for some three days, and some hurried arrangements were urgently necessary. Eating and sleeping in the same room was sorted out after an interview with the Urban authority, and a large and increasing dump of refuse was cleared, with a promise of regular removal. A public lavatory was cleared, cleansed and taken into use. And so round the rest of the area to get a general idea of conditions and the problems to be tackled.

It was obvious that the most pressing problems were cooking and washing. For washing, as there are no public baths in Ely, the solution was "Soyer stoves" and these were indented for at once. A school near the Drill Hall was explored and an ablution room with concrete floor was found, with ample cold water supply. The only objection or possible difficulty was that this was a girls' school. A visit, therefore, was paid to one of the School Governors and after a friendly chat, we got permission to use the school under certain safeguards.

This was at once available for cold ablution and on the arrival of the "Soyer's stoves" and "Tin-tubs," hot baths were at once got going.

The remainder of the Soyer's stoves were sent to Welney with a bathing tent, the siting of which was a problem in itself, as no dry patch of land existed there, in which to stick a tent peg! However, after prolonged search a sticky patch of ground behind the houses was found and the tent set up. Incidentally we found that the village did not boast of a single bathroom anywhere, except in one house and the vicarage.

Cooking for this field force was important, especially at Welney where an ample supply of suitable hot food was especially necessary owing to the arduous conditions and irregular hours of meals for working parties.

Two petrol cookers were in use, one at Ely and one at Welney, working in the open. This type of trailer-cooker is satisfactory and in bad weather a fair amount of protection is afforded by side-curtains. It supplies approximately one hundred men, though this is rather working to capacity. Two small disadvantages attach to this type of cooker, (a) it requires a trained man who has been instructed in its use, and (b) it cannot be used whilst actually moving on the march. It is understood, however, that this type is now being superseded.

A third cooker was asked for, obtained, and sent to Welney. In addition, medical comforts, mostly soup and cocoa, were supplied and in this way plentiful hot food was available for men coming in relays at any hour.

At Ely, the Royal Corps of Signals were employing the petrol blow-lamp type of cooker, working in the manner of a trench-fire. This was under cover and worked well, but would not be suitable for an exposed position.

As regards sleeping accommodation, no arrangement about bedding could be made in the time. In this connexion it is interesting to note that on suggesting the possible supply of straw palliasses, it was found that owing to the proximity of Newmarket, straw would only be available in small quantities, and at a prohibitive price, so the idea was impracticable. The troops, therefore, who were not in billets, "slept hard" during their stay.

Latrine accommodation everywhere proved barely adequate. In Ely a four-seated public latrine with urinal, beside the Drill Hall, was sufficient for the Central Camp. At Welney, one deep-pit was dug and, with the school latrine this was enough. At Upwell no difficulty arose in this respect.

And so, at the end of the fourth day all arrangements were working smoothly, and the Force could have operated with comfort and safety for a much longer period, than the actual ten days period.

The general atmosphere of apprehension continued ; each day a fall of snow was feared, but luckily this did not materialize and a definite change for the better came on Saturday, March 27, and the Civil Engineers became almost happy. It was curious to note how the swarm of newspaper representatives began to scatter as the prospect of a break grew more remote, and by Sunday night they had all faded away, like birds of ill-omen. Even reporters' imaginative writing could find nothing more to feed on.

And then at midnight on Monday, March 29, the climax was reached ; the high tide did not reach the danger-mark, and the Civil experts gave the "all clear." Forthwith troops began moving and by Thursday the district was clear. Thus ended an extraordinarily interesting exercise with troops, which must have given many young N.C.Os. and men an insight into conditions approximating to active service. It was most noticeable that some men showed the old soldier's facility for finding comfort in discomfort, whilst others endured rather than enjoyed it.

From the medical aspect it is interesting to note that no casualties occurred due to catarrhal infections, and in fact the ample supply of hot food, the drying of clothing, and the keeping up of fires in sleeping places day and night, was responsible for this freedom. In addition, the issue of rum was, I think, of great value, but as this has been a debatable point on more than one occasion, we may leave it. The medical diary showed only a few minor casualties ; cuts, a boil or two, a cut lip and face, due to an abortive acquaintance with a motor-cycle, and a rather nervous individual who said he had only been in Ely a couple of hours, and could he have an E.T. packet ! whether a pessimist or optimist, who can say ?

One bad road casualty to a despatch rider occurred, with concussion and a fractured base.

Apart from these, action on the medical front was of an organizing and supervising nature. In this connexion may one strongly put forward the suggestion that in any similar circumstances the Medical Services should have a representative amongst the earliest arrivals on the spot, so that a preliminary survey of the position can be made and much delay saved.

And finally, one cannot end these notes without referring to the good relations established with the civil population in general. Everywhere the men were made welcome, and I, personally, met with the greatest goodwill and anxiety to help in every way. One can only hope that such an emergency may never arise again.

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## Editorial.

### RECENT RESEARCHES ON CHOLERA IN INDIA.

DURING the past few years there has been a suspicion in the minds of medical officers in the East that the agglutinating sera with which they are provided are not always able to distinguish the cholera vibrio from other vibrios.

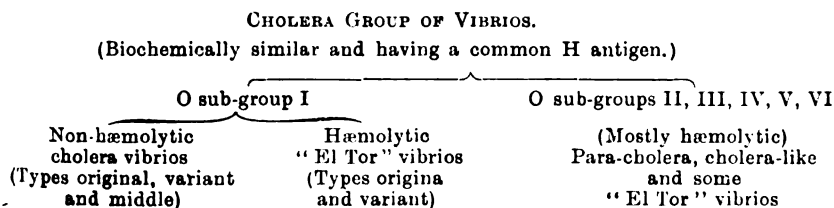
Dr. A. D. Gardner and K. V. Venkatraman examined 100 strains of cholera and cholera-like vibrios and described the vibrios as typical, atypical or non-fermenting. The typical vibrios produced acid without gas in glucose, mannite, maltose and saccharose, gave the cholera red reaction and did not ferment dulcitate. The atypical vibrios diverged in one or more characters but had a general resemblance. The non-fermenting vibrios did not produce acid in any of the carbohydrates mentioned.

Gardner and Venkatraman applied the term cholera group to vibrios of the typical and atypical classes which presented the main characters of the *Vibrio cholerae*. They found that the vibrios in this group had a common "H" antigen. The group contained a great diversity of "O" antigens, six of which were found in more than one strain and eight others in single strains. The former were classified in sub-groups I to VI and the latter as individual strains. Absorption of an "H"—"O" serum with homologous "O" suspensions removes all agglutinins for "O" suspensions of all species but leaves the common "H" agglutinin intact. Absorption of an "H"—"O" serum with an "H"—"O" suspension of a different "O" sub-group removes the "H" agglutinins for all species but leaves the "O" agglutinin intact. All the standard cholera vibrios received from various laboratories and most of the vibrios isolated from cholera cases belong to sub-group I. They are non-hæmolytic.

In sub-group I were three types : Original, variant and middle, obtained from the State Institute for Infectious Diseases, Japan. They were agglutinated by "O" serum of that sub-group, and the "O" sera of the Japanese races similarly agglutinated "H"—"O" suspensions of various sub-group I strains. They also possessed the common "H" antigen.

By cross agglutination and absorption tests it was shown that the original (Inaba) and the variant (Ogawa) had in addition to the main "O" antigen a subsidiary "O" component.

The following working scheme is suggested for the cholera group :—



Gardner recommends that the use of sera containing the non-specific "H" agglutinin should be discontinued. The serum must contain the characteristic antibody of sub-group I and must be made in such a way as to avoid the forms of non-specific agglutination. Such a serum can be prepared with a suspension boiled for two hours so as to destroy the "H" antigen. The cultures under investigation should not be heated.

As a working rule he also suggests that only non-hæmolytic vibrios of sub-group I should be accepted as proof of cholera or the cholera carrier.

The hæmolytic "El Tor" vibrios are serologically diverse. The term "El Tor" should be reserved for those having the same specific "O" component as the standard cholera vibrios.

In order to secure an effective prophylaxis of cholera the Permanent Health Committee of the League of Nations considered that researches should be carried out to ascertain : (1) What are the characteristics of the true cholera vibrio and with what antigen an agglutinating serum should be prepared so as to be specific for the pathogenic vibrio. (2) Whether vibrios which are not agglutinable by specific anti-cholera serum are capable of causing cases or epidemics of cholera, and must, therefore, be taken into consideration from the point of view of prophylaxis.

At a conference of the League of Nations held in 1935 it was decided, at the suggestion of Dr. M. T. Morgan, that specific antigens for the cholera vibrio from which the non-specific "H" antigen had been removed should be supplied for experimental work to be carried out under the direction of a Consultative Committee in certain centres in India.

Dr. Bruce White prepared at the Laboratories of the Medical Research Council suitable antigens of the cholera vibrio and sent them to Dr. Gardner for examination and testing at the Standards Laboratory, Oxford. Dr. Gardner tested the antigens and sent to India two types representing the original Japanese type (Inaba) and the variant (Ogawa).

Sera prepared by means of these antigens have been used in various parts of India for testing strains recently isolated.

Reports have been received of experiments carried out at Kasauli under the direction of Colonel Taylor, I.M.S., at the Pasteur Institute of Shillong under the direction of Lieutenant-Colonel L. A. P. Anderson, and at the King Institute of Guindy, in Madras, under the direction of Dr. C. G. Pandit.

Dr. Gardner, commenting on the report from Kasauli, stated that of 432 strains examined there were 130 (obtained from cases of cholera, from carriers, or from water) which would have been considered agglutinable if the old serum "HO" had been employed, but were at once distinguished from the true cholera vibrio by the fact that they were not agglutinated by the serum "O."

The reality of this distinction was confirmed by the fact that 110 of these vibrios differed from the typical cholera vibrio in at least one biochemical reaction. The strains agglutinated by the serum "H," non-specific as regards serum "O," were very heterogenous from the serological point of

view. In the series examined none of the carriers furnished any strain agglutinable by the serum "O."

The report from Lieutenant-Colonel Anderson at Shillong contained some interesting observations. In the region of Habiganj, where the bacteriophage was employed and where there had been sporadic cases of cholera and a few small epidemics, a large number of vibrios were isolated which gave all the biochemical reactions of the *V. cholerae* but were only agglutinated by an "H"—"O" serum. Nevertheless, on examining a large number of colonies at least one strain was found which was agglutinated by serum "O" to about 50 per cent of its titre.

In certain cases of cholera, about which there could be no doubt as to the nature of the illness, it was not possible to find true cholera vibrios, but only vibrios inagglutinable by all the sera.

Typical strains agglutinable with "O" serum were found only in cases of cholera, and the biochemical reactions of all the strains were those of the typical cholera vibrio.

Dr. Pandit in Madras examined 226 strains isolated from true cases of cholera and found only seven strains which were not agglutinated by serum "O."

All the reports confirm the statement of Heiberg that specific agglutinable cholera vibrios (Group I) produce acid in mannite and saccharose but not in arabinose. They also show that many vibrios not belonging to the "O" agglutinable I group also give the same chemical reactions. None of the typical "O" strains of the cholera vibrio caused hæmolysis of goat's blood.

Although all the tests employed were not uniform in the three centres certain facts appear. In the series at Kasauli not a single specimen of the type Ogawa was found, and there was no evidence that this type existed at Shillong. At Guindy, in Madras, the variety Ogawa was represented in 18 per cent of the strains, and of these more than half had been isolated in the district of Madura, where an epidemic due to Ogawa alone appeared after the completion of the report.

Dr. Gardner, after perusing the reports, arrives at the following conclusions, which were also approved by Dr. Bruce White.

The facts obtained from India fully confirm the idea that the diagnostic serum containing specific "O" agglutinins but no "H" agglutinins will separate a group of vibrios, which without doubt cause epidemic cholera, from other vibrios whose pathogenic action is at least doubtful. The importance of this discovery in the search for carriers is evident. It is clear that all the specific "O" vibrios give the biochemical reaction of the type I of Heiberg (mannite +, arabinose -, saccharose +), which though not peculiar to the true cholera vibrio, should be determined in future investigations.

Inability to hæmolyse goat's red corpuscles is an invariable character of the specific "O" vibrios described in these reports. Despite an extensive

examination of healthy individuals and carriers no "El Tor" vibrios (which are agglutinable with specific "O" serum, but are also hæmolytic) were found. This strengthens the idea that vibrios in a state of pathogenic activity are invariably non-hæmolytic. For correct diagnosis the use of a serum type "O," bivalent or mixed, is recommended, separate sera of "O" type being reserved for scientific or epidemiological investigations.

In his commentary on negative or doubtful bacteriological researches on clinical cholera, Dr. Bruce White writes that it is possible that the bacteriophage when present may reduce considerably the proportion of cholera vibrios to secondary invading vibrios, which multiply without restraint. He considers that this state of things probably occurred at Habiganj. When the agglutination is doubtful or partial the absorption test should always be performed.

A rough variant of the cholera vibrio which appears under the selective influence of the type "A" choleraphage is not agglutinated by a smooth anticholera "O" serum. The morphology of the rough colony varies considerably; it has a dry and solid consistence and a network of striations can be seen with a magnifying glass.

Bruce White states that the fact that only the rough forms can be isolated from a case of cholera does not necessarily imply that this form is pathogenic, or that the smooth form may not be the real cause of the cholera state. The influence of bacteriophage "A" during culture should not be forgotten.

Strains of the cholera vibrio isolated from clinical cases, carriers, and from water which proved inagglutinable with sub-type "OI" serum; have been sent to Kasauli by Committees of Inquiry working in cholera zones in India. Some 558 strains have been examined serologically with serum "O" prepared against the sub-types II to VI of Gardner and Venkatraman as well as with sera prepared with twenty-six specially selected Indian strains. It has not been possible with these sera to group more than 50 per cent of the strains studied. Nevertheless, it is worthy of note that no series of cases of clinical cholera has ever been attributed to infection with any definite type other than sub-type "OI."

Studies of the rough cholera vibrio, prepared according to Bruce White's method by the action of a bactericidal serum, have been made and similar results to those of Bruce White have been obtained.

A high titre serum prepared against the rough strain of Inaba has been employed for the examination of strains recently isolated, and certain strains from cases of cholera have been agglutinated by it.

## Clinical and other Notes.

### NOTES ON A CASE OF GANGRENOUS STOMATITIS IN A SOLDIER.

BY MAJOR S. H. WOODS, O.B.E.,

*The Army Dental Corps.*

WHILE looking up some old records I came across notes and a photograph of this unusual case which may be of interest.

Pte. McN., aged 25, service eight years.

Admitted February 24, 1930, to Queen Alexandra Military Hospital, Millbank, London.

*Previous History.*—While serving in India in 1925 he developed a chronic rhinitis and a turbinectomy was performed in 1926, resulting in freedom from nasal trouble till July, 1929, when he reported for nasal discomfort and discharge.



Death Mask.

He was under treatment at intervals, but the discharge increased in amount and offensiveness and he was invalided to England in February, 1930, with the provisional diagnosis of sarcoma of the ethmoid bone. There appeared to be no glandular involvement and the general condition of the patient was good.

Three days before the transport arrived in England the patient's right cheek became swollen and oedematous and perforated in twenty-four hours.

*Condition on Arrival at Netley, February 22, 1930.*—"Perforation now



2 by 1 inches, right alae nasi eaten away, much discharge of foul pus. Fluctuating swelling of palate, temperature 101° F. No evidence of secondary growth in chest or bones on X-ray examination."

*Next Day.*—"Slough now 3 by 2 inches. Temperature 103° F."

Patient was transferred on the 24th to Millbank, by special ambulance, as his home was in London.

He died on March 2 and I took a death mask. The destruction of the tissues is shown in the photograph. The right maxilla was almost denuded of its gum and periosteum and the teeth were loose, but the mandible seemed to be unaffected.

As the parents refused permission for a post-mortem examination, the true nature of the nasal condition was not ascertained.

The sudden onset and rapid spread of the stomatitis may have been due to thrombosis of the facial vessels, and also to a lowering of local resistance.

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#### A FURTHER CASE OF IMPACTED WISDOM TEETH.

BY MAJOR G. W. WILL, O.B.E.  
*Royal Army Medical Corps.*

PRIVATE S. M. was admitted to the Royal Victoria Hospital, Netley, on July 14, 1937, having been invalided from India with the diagnosis of "Hysteria."

He had begun to get worried and depressed about August, 1936, but this did not interfere with the efficient discharge of his duties. He was treated in hospital at Ferozepore from December 14 to December 21, 1936, suffering from vertigo, complaining chiefly of dizziness on standing. He was readmitted on February 24, 1937, having been found wandering in an unbalanced state of mind. When he appeared before a medical board on April 13, 1937, he complained of pain over the top of the head and a constant worry lest he shall have another attack of wandering. He appeared to have complete amnesia for the attack, but knew that something had happened. He then had a marked tic, moving his head in a jerky manner. There was a coarse tremor of his hands and he ground his teeth when engaged in conversation. This tic had been noticed for at least eighteen months. It was noted that while in hospital he occasionally awoke at night with a feeling that the bed was rocking under him and a feeling that he did not seem to know where he was.

When admitted at Netley there were no signs of any gross mental disorder. He appeared a little depressed and anxious, but expressed a desire to return to duty. He complained of a fairly constant headache—left lateral and vertical—and of a buzzing noise in the left ear. He said that he had noticed his habit of grinding his teeth, but could not say when

it had started. He could not remember wandering away at Ferozepore, but said that for some time after he had been afraid that he might have another attack and "do something" during it.

There was a marked tic of muscles of the head and face and a coarse tremor of both hands. Tendon reflexes were rather active, but otherwise there were no physical signs. The optic discs were normal. Urine was normal. Wassermann and Kahn were both normal.

X-ray showed that both lower wisdom teeth were firmly impacted.

The seventh lower molars were both extracted in order to relieve pressure and allow the eighth to erupt. There was an almost immediate relief of symptoms, inasmuch as the buzzing noise in the left ear stopped. There was a temporary increase in headache, but within a fortnight he said that he had not felt so free from headaches for months. The tic had also disappeared, and he did not appear so nervous when talking. He had stopped grinding his teeth. The tremor of the hands remained.

He was discharged to duty on August 24, 1937, with the recommendation that he should have a month's leave.

There is another side to this case. It appears that he has been worrying for some time about an affiliation case which has been pending for the last five years or so, being held up while he was in India. He claims that he is not the father of the child, although his relationship with the mother was sufficiently intimate. This has been worrying him for some time, and the nearer his return to India the more acute the worry. He is now prepared to face the inevitable Court proceedings. How far his now confident state of mind is due to advice and what might be called "therapeutic conversations," and how much is due to a general improvement following the removal of the impacted wisdom teeth, I am not prepared to say. That his fugue may have been largely due to purely psychological causes is undoubted, but it seems possible that the reflex irritation from the impacted teeth may have set up a state of mental unbalance in which he was less able to deal with his worries than would otherwise have been the case.

The only other illness from which he has suffered was a mild attack of sandfly fever at Landi Kotal in 1934. The effects of this must have long since worn off. I have entirely disregarded any possible effects of climate. He arrived in India on December 10, 1932, and served chiefly at Landi Kotal and Ferozepore. Neither is a station of choice but his final breakdown occurred in the month of December when the climate of Ferozepore might reasonably be described as salubrious. I am hoping that his future will support my belief that the chief causal factor was the impacted wisdom teeth.

I wish to thank Colonel G. F. Rudkin, D.S.O., Commanding the Royal Victoria Hospital, Netley, for permission to send this case for publication.

## Travel.

AFRICA, 1934.

BY MAJOR D. GORDON CHEYNE, O.B.E., M.C.

*Royal Army Medical Corps.*

THIS is the story with photographs of my tour to East Africa undertaken at the kindest of invitations from my sister and her husband, John Mitchell, my friend of nearly thirty years. We little thought when we first met about 1907 or 1908 when he did my father's work, or later in 1910 when as a very young man I arrived at the Royal Waterloo Hospital, London, to be his junior, that after many years he would be meeting me at the end of the Kenya Uganda Railway as my brother-in-law and host for what was to be a memorable tour. But so it was and here is the story:—

We had arrived at Bombay at the end of 1932 and in 1933 we did not take any leave, so it was decided that H. M. and Peter should go to England where H.M. had her folks still going strong and anxious to see them both. I had not such pressing calls to the old country just then and when an invitation to come to Africa arrived I decided to accept.

One of the greatest advantages of living in Bombay is the ease with which one can leave the place and many think that the best view of Bombay, and incidentally India, is from the blunt end of the ship going out of Bombay Harbour. I don't agree with this. India has not been too unkind to me since 1919 when I first knew it. The family sailed off home in April and I was left to work things out for myself until June. By that time I had made all arrangements for my great adventure and June 13 saw me pulling out of Back Bay House, Colaba, and making for the dock in which the good ship "Kenya" lay. I was seen off by Sandy Mearns and Colonel Loughnan. "Seen off" is a good way of putting it for it was a very good party. It was pretty dark and the clouds were low and there was distant thunder. But does anyone care for little things like that when he has leave papers in his pocket and is already on a ship?

We had not reached the gates of the docks when there was almost a complete black-out and down came the rain in sheets and the thunder rolled immediately overhead. This was the start of the Indian monsoon and it was some monsoon. People on shore said we were going down the channel in the wrong direction but I doubted it. Anyhow once outside the harbour we found it was not too bad. Fellow passengers were few, Sir Charles McWatt, a retired D.G., I.M.S., Captain Charles, a nursing sister returning to Africa from New Zealand, and a young Australian going out to try his luck in Africa.

First impressions of the ship, the cabins and the people were good. We did not see very much of the officers that night. We soon settled down to things as we were to be a week before touching anywhere. Bridge, deck

golf and the like filled in the days and they followed each other all too quickly. Sir Charles never appeared till lunch time so we formed our own little party. We were taken all over the ship, and also saw the third class accommodation which was interesting to me as this class of ship can be converted to troop carrying in a very short time. There is a big trade with Indians to and from the African coast, and people do not as a rule realize what vast numbers of Indians have settled in various parts of Africa. A year later a sister ship of this one was taken over by Government to carry the unfortunate British refugees after the Quetta earthquake.

And so the days passed. We crossed the equator but nowadays there is no ceremony or tamasha as some one complained about it.

About seven days out we headed for the Seychelles Islands. Approaching them one appreciates how mountainous they are. We lay off and were rowed ashore by some of the blackest people I have ever seen. Outside was a reef and the waves breaking over this was a lovely sight. The town was small and not very interesting.

I got the impression that there was too much missionary influence. The girls wore a sort of uniform which for drabness would be very hard to beat. The men looked lazy. We got hold of a car and went for a drive up some of the hills and had some fine views of the beaches and lagoons. The water was beautiful and green on the top of golden sand. There was a delightful bathing beach declared safe so we had just time to sample this. We had to put off soon after.

On the tenth day out we entered the channel for Mombasa which is narrow for a few miles and then opens up into a very pretty harbour. There was one or two Union-Castle ships about. We had passed some very pretty houses on the way up and I think one was said to be the East African residence of the Aga Khan who has big interests in these parts. We also came alongside some very charming residential parts which were pointed out as the nicest parts to live in. Everything was green—a lovely soft green, indicating plenty of rain and lots of heat which I understand are the chief characteristics of the Mombasa climate. Mr. McNiell, a friend of my brother-in-law and sister, was waiting for me. We went first to the hotel for a quick one and then saw about trains. We found that the trains went up country only twice a week but if we liked to make our own arrangements about food the railway people would put a carriage on to the goods train. The alternatives were to wait in Mombasa or to fly. We decided to go that day and we sent off two of the young people to buy food, provender and things for the party. They came back laden with all sorts of good things and beer and even knives and forks. They did not intend that any of us should starve. I had a charming lunch with the McNiells in their very attractive house. We got to the station about 4 o'clock and found that we should be quite comfortable. I had wired the Cormacks that I hoped to break my journey at Nairobi and see them. We started off and soon were climbing, for this is a most remarkable railway in that it goes

up to 10,000 feet high in parts. These railways provide for a small charge a roll of bedding, guaranteed disinfested which you have for the journey. India copied this at a much later date. The carriages are large, rather like the Indian ones, and the bathroom and lavatory accommodation are good. At meals in the train, which I had later on the Uganda section, and coming back again, they give you the most attractive menu cards which have drawn on them a cross section of the country through which the railway runs. Before long we had run through the Kikuyu country which came in for a good deal of publicity a few years ago over some religious questions. The country was interesting and was everywhere intensely cultivated. There were lots of coffee and good crops of maize, and the cattle looked good.

We passed through Tsavo. One remembered reading as a young man that grand book of Harrison's called "Maneaters of Tsavo," and which deals with the pioneer work in building this very section of the railway and tells graphically of the encounters here with lions. One very good bit I remember narrates how lions used to come around at night and sniff into the carriages in which the personnel slept and how one night a lion came and sniffed at the man who was lying in the lower berth and did not like him, so climbed up and had a sniff at the fellow in the top berth and, liking his aroma, carried him off. I think I am right in saying that the man who was not taken is still living at Nairobi. He could quite easily be as I met the missionary people at Kampala who had walked up this very route even before the railway started.

I don't think any of us slept much that night, whether on account of the lion tales which were told or not, I don't know. I think we were all afraid we might miss something good. Anyhow morning came and we were up a few thousand feet and it was quite cool. Soon we arrived somewhere about the famous Athi plain which extends for miles before you reach Nairobi and we were now all on the alert to see what game we should pass. We did not have long to wait.

Soon we saw hundreds of zebra, wildebeest, and in the distance I saw a herd of some half a dozen giraffe. I also saw a wart hog. There was also a fair amount of small deer of various kinds like Thomson and other varieties of gazelle. Lions have been seen from the train on many occasions but not on this. I am told that three blasts on the whistle means that the engine driver has sighted a lion. This time there was silence. *En passant* it was interesting to remember that it was along a line more or less parallel to this that the force advanced up country after they had finally landed at Tanga, where a disastrous attempt had been made in the first place, to be followed later by success during the Great War. And so we came to Nairobi which we reached about noon and were then up 5,500 feet. There is a nice station and all appeared up to date, including my friend Robin Cormack whom I had not seen for some years as he had left the Corps and had joined the Colonial Service. He was stationed here and was in

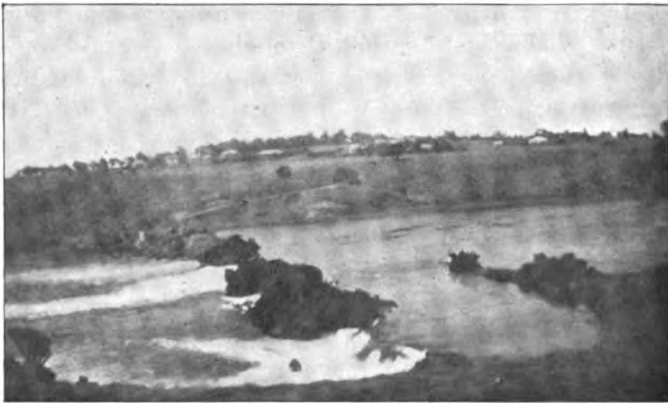
temporary charge of the Government Laboratory. He had hoped that I might stay with him some time, but they had made arrangements to go off for a holiday then, and I could only stay one night, but I had a very cordial invitation to come back and stay with them on my return journey. I decided to go off the following day to Uganda so I shall tell you all about Nairobi and Kenya later on.

While I was in Nairobi I was interested to see the arrival of the air mail from home tick to the minute. This was the first time I had seen the organization close up. I was told that there had been some trouble at the aerodrome as there was a rhinoceros hovering about which they had not been able to catch or drive away. After leaving Nairobi we soon approached the region of the Great Rift Valley. This is a marvellous natural cleft in the world's crust which extends right through Africa and then goes away over Asia Minor where I believe it reappears as the Jordan Valley and from there goes off somewhere else. We went for miles around the cleft; it extends for miles across and is highly cultivated. At last one came to the edge of it which was like the side of a great wall. In the Rift itself were extinct volcano craters, so at some time in the history of the world's creation there must have been some turmoil around these parts. We were now in a highly cultivated part of Kenya where cattle rearing and dairying appeared to be the chief industries. They had a co-operative system of selling their goods as I noticed advertisements about it at the stations. This appears to be a good system when one remembers the great distances from a port. We passed Naivasha which seemed a most attractive place and rather like a holiday resort as there were some very nice bungalows and hotels there with good sailing and presumably fishing on the very extensive lake. I think it was from here that one had a view of Mount Kenya lying away to the east. As the evening fell we came to Lake Nukuru.

Lake Nukuru must surely be one of the sights of Africa if not of the world itself. This is the lake upon which millions of flamingo live and which from a distance has a beautiful pink appearance from the feathers of these millions. The birds were resting when we passed and I am told that their density is so great that they have to have a perfectly organized arrangement for their taking off—the birds on the outside have to take off first. I have confirmed that something like this is correct from seeing it on the cinema. This area of Kenya has attracted most settlers and they seemed to be everywhere. Like most other parts of the world they are suffering from the depression and over-production and it was said there was a great excess of coffee in the country and also that there was no market for the miles and miles of sisal which one saw growing in areas of what must have been thousands of acres. The highly developed and very rich gold mines of Kakamega (or something like that name) are on the shore of Lake Victoria somewhere in this region. And so night fell and to bed for there are big things to be done on the morrow.

During the night I crossed the equator by train at a height of nearly 9,000 feet; it was very cold and I was glad of all my coats. In the morning I woke to find we had got to Tororo and were in the Uganda protectorate. It seemed that we had entered a never ending banana grove for we passed through miles and miles of this. We had descended to under 4,000 feet and it was warmer.

About breakfast time I was warned that we were approaching Jinja and would get a view of the Ripon Falls. These falls represent the rise of the White Nile from Lake Victoria. The White Nile meanders through Uganda to enter Lake Albert after tumbling over the Murchison Falls,



The Ripon Falls, Jinja.

about which more anon. The Ripon Falls, as seen from the train, did not appear to be very high, but they were very broad and are spanned by a good bridge from which I took several photos, my first from a moving train, and I was very pleased with them. There were some houses on the high area, and the fishing here is said to be marvellous. Fish are frequently seen jumping the rapids, but whether these are something like our salmon I know not. More banana groves and still more, and then towards noon or a little later the area clears and we pull into Kampala the end of the railway, some eight hundred miles from the coast. This is a hilly place, and it is sometimes called the Athens of Africa from the fact that it stands on seven hills. It is about seven miles from Entebbe. This is the official capital of Uganda, while Kampala is the business capital and also the medical centre, and where the chief places of education and learning are situated. John met me and whipped me off. Up the hill of Mulago and past the hospital buildings and right up to the top of the hill, and there stood Loui in her lovely garden waiting for me.

Loui and John's house was just what I would have expected it to be. It is a bungalow built on the top of the hill and surrounded by large terraced gardens, with here and there a large rose bed. Now everything is blooming

in great profusion. My first impression of Africa was how beautiful all the gardens are, and this impression grew and was accentuated with my greater knowledge of this particular area. All around the house was a great archway of *Buganvillea*, orange, I think, but it was not out and there was also an enormous archway of the same shrub outside in front of the entrance. There was also a nice fernery at the entrance of John's room. Here lived the parrot, and he was a great talker. His best was to butt in with "What's all this rubbish" when one thought one was really talking well. I distinctly heard him imitating Loui's voice with "John, have you got an aspirin?" The other pets were an Airedale dog, Paddy, who, I believe, met a violent death later, having been bitten by a black mamba and another fox terrier. In Africa it is usual for the room in which a guest or guests live to be separated from the house proper, and both here and in the Cormack's house in Nairobi this was the case. There is a lot to be said for it. Loui's guest house was in the garden, and had been the old lab. It was most comfortable, but later I slept on the verandah. There was a very nice swimming pool in the garden.

The house is very nicely furnished. The lounge is a large room, and in it are many treasures collected by John from various parts of the world, especially Abyssinia. A large Zanzibar chest is notable, and I was lucky in being presented with one similar, though smaller, before I left. The dining-room was small, but cosy and attractive, especially at night when we had dinner by candle light. There is no electricity on the hill which, with all the mighty water power at the back door, as it were, is an anachronism. Loui has developed into a complete hen and chicken woman, and has a large stock of choice ducks and chickens which produce large eggs, and when the time comes to eat a chicken it is an occasion in the station, and well it might be so considered for I have seldom eaten better. I quickly settled down to life here after I got accustomed to the height and to the very strong coffee. I met charming people everywhere, all of whom were very kind to me and invitations to dine and wine were all too frequent. I went over the hospital on many occasions, and it was a revelation to see how things had developed since the Government had taken over. Before all the medical work had been in the hands of the mission hospitals and about them I shall write later. Here was a fine staff of medical officers, sisters and subordinates. Here also has a start been made with the creation of a medical subordinate service similar to the Sub-Assistant Surgeon branch of the Indian Medical Department, and John has played and is playing a prominent part in its creation.

I met some of these young Africans and played tennis with them. They have been educated entirely in Kampala, first at the High School, which is, I am told, modelled on Eton, and later at this Medical School of Mulago which I presume is fashioned after Aberdeen. The idea is that these young men should be in charge of District Dispensaries and ultimately of Districts. At present they belong body and soul to Government and here may lie the



difficulty in the future as these same young men will want to get the richer prizes as a reward for their labour and to refuse these would seem unreasonable. This African Eton College is housed in lovely buildings with glorious playing fields and the outcome of this great experiment with young men whose fathers were comparatively uncivilized in the European sense, will be full of interest. One should mention that the African of all classes is a proud man with nothing of the servile about him. That accounts for the servants being so appallingly inferior to the Indian. Left to himself the male African would do nothing but wait for his women folk to go out and plough the land and bring home the produce. The gent that Loui so kindly produced to look after me was a complete washout and just stood by and watched me doing things for myself. The fact that I had come from overseas seemed to impress him in a kind of way. They are as a class dishonest and thefts are all too common. In the house they wear long white gowns and small black caps. They wait efficiently at table and if watched do not do too badly.

Kampala, in common with other parts of East and South Africa, is full of Indians. I was much impressed on the way up to notice that all the station staffs were Indian, mainly Sikhs, and I talked with some of them. They all looked forward to their return to India, and judging by the very large numbers travelling by the ships many realize their ambitions. In the stores, which are also run largely by Indians, including lots of Parsees, you will find the second generation going strong and maintaining the Indian purity of stock; this generation had never seen India. Mr. Pinto, who ran the grocery store patronized by Loui, was most interested in hearing the news of Bombay, which he had left many years previously. Kampala is a large town very well laid out with good roads and good houses. There is a lot of trade with the surrounding district. There are many motor cars and lorries, and one noticed how popular the box van was with its front seats like the usual front seats of a private car, instead of the usual back seats. This part of the car was converted into a van sort of affair, sometimes open, sometimes closed. This is for safari, when you travel in comfort and behind you have all your tentage, stores, beds, and so on.

Dominating the place are two hills upon which are erected the two cathedrals, the Protestant and the Roman Catholic. The Protestant is just a shade higher. (Nearer to Heaven, perhaps.) I visited both these cathedrals which are very handsome buildings. In the vicinity of the Protestant one are buried some of the unfortunate people who were massacred during the early days by—was it King Mutesa, whose tomb I later visited? He was a real old rip, whose form of amusement to chase away boredom was to throw a few of his enemies to the crocodiles. I met Sir Alfred Cooke, one of the pioneers of missionary work in these parts and one of the party who had walked up from the coast—a grand old man and I believe in his time a very fine doctor. They have a large hospital well equipped, but it is obvious that the coming of the

Government hospital has taken away a lot of its usefulness. It is the same thing with Roman Catholic places, though I was impressed with their infant and women work ; as the sisters and medical officers work for miserable salaries I think these people are deserving of the very greatest praise for their good works to suffering humanity. In these institutions are African women trained for the nursing services and to be midwives, and they are turning out very well. The trouble is the lack of morality. This seems common all over the Protectorate and the venereal problem is a big one, in fact the biggest medical problem. I saw one small girl, a missionary school attendant, a victim of an acquired syphilis. There is a good system of venereal disease treatment in the districts which should have good results.

I had a very interesting visit to the prison situated on the way to Entebbe near Victoria Nyanza. Note in talking of the African lakes one can say Lake Victoria or Victoria Nyanza, not Lake Victoria Nyanza one so often hears as "Nyanza" just means lake. This was a large very well built place surrounded by high walls and guarded by the Askaris who appeared very smart. The superintendent showed me all over the place and John and his assistant demonstrated a few medical things notably examples of deficiency diseases. I saw the prisoners at various sorts of work and also their kitchens. The staple food is M'toki which consists of a mixture of banana and maize. I think recent researches have shown that a little meat and sweet potato is sufficient with the M'toki to keep the men fit and to prevent deficiency diseases, notably keratomalachia which I saw for the first time, having lectured about it many times at Millbank. I also visited the area where those condemned to death are kept pending a reference to Government and during the hearing of various appeals. At the time of my visit there were eighteen awaiting their fate. Most of these had been convicted of arson upon which the Courts look very seriously, as arson with the intention of catching someone in the hut which has been fired has become much too common. I had a demonstration of the hanging process without a victim and was told that it took only six seconds from the time the victim left the cell till he had reached his destination off this earth.

One day we visited Bombo and called on the King's African Rifles. The camp was very orderly, with the little beehive huts. The men were smartness personified. They are officered by men seconded from the British and Indian Armies who do about four or five years in one of the various stations. I also met them in Nairobi. I was serenaded by a great big fellow with a fiddle fashioned out of a gourd and was told that the translation of his song was that I must be a great big white chief who deserved a good wife and that doubtless I had one at least though I deserved two. Wonderfully wise these people.

We called on some of the district dispensaries and saw the work. One was struck by the good manners of all the people on the roads. Most

people gave us a greeting and got out of the way of the car. I picked up a few words of Swahili and when somebody said "Otiano" one could reply "Bullungi", which was much appreciated.

I had several very good days at Entebbe which as I said before is the official, very official, capital. The Governor was away so I did not get called to General Headquarters. I met all the medical staff from the Director of Medical Services downwards and duly accepted their food. We were mutually interested in each others problems. I saw the lab. built at enormous expense for Lyndhurst Duke and never occupied by him. I recollected that the R.A.M.C. had taken a prominent part in the early investigations into sleeping sickness, when Bruce, Gray, Hamerton and Bateman had all worked here or in this area.

And so the days passed. Plans had meanwhile been maturing for a safari on the real grand scale and it was proposed that my first tour around should be to give me an idea of the vastness of the country and would be something in the nature of a circular tour of the northern part of the Protectorate skirting the Belgian Congo. I had investigated the possibilities of visiting the Congo before leaving Bombay, but the Belgian Consul General had not been at all helpful and suggested that I might be liable to put down 1,000 Belgian pounds beside having to be certified as free from every disorder including pregnancy, so I decided against this. Well on the first day of the safari we started off. The party this time was Loui, Mrs. Hopkins, afterwards referred to as Doris, and myself in John's very powerful Fiat well loaded up with good food and drink and with sixteen gallons of petrol in a box as a reserve. We were making for Fort Portal where we were to stay the night on the way to the Ruwenzori Range of mountains popularly known as the Mountains of the Moon. The run was through very interesting country and one of the most pleasant recollections of that day was the enormous number of butterflies we saw. We passed through clouds of them. The radiator of the car was thick with them when we stopped. The ground where it was wet was also thick with them. We saw lots of guinea-fowl but no other game. The route was via Mityana and Mubendi, small places. Approaching the mountain passes we ran into a big thunder storm with heavy rain. We pulled into Fort Portal all right after negotiating an avenue of papyrus grass which ought to have harboured elephant and probably did.

We lived in Busirasigama, the bloody hill, so called, after some battle in which General Lugard took part. We arrived latish and had not much time to see things, but here again was a glorious garden, a delightful house, really a private house belonging to people called Paul. Mrs. Paul was the daughter of Dr. Neilson and both he and his wife hailed from Aberdeen. Paul was in coffee which for some reason was not paying here and they were running their house as a private hotel and doing it very well, too. Mrs. Paul had all the brains of the partnership. They promised us a good view of the mountains on the morrow. We met a lady there who was

about to climb the group which is not an easy matter. I think she succeeded, but her husband who was prospecting in Lake Rudolf was killed about the same time. We were 5,200 feet up here and were glad of fires as it was cold.

Next morning we started off early, passing along Paul's "Shamba" where a few nights before there had been sixteen elephants. I may say here that there was a good deal of this the-night-before-stuff during my tour, especially as regards lion which I might as well admit now I never saw (loose I mean). "If only you had been here yesterday when I was driving with my children, when little Willie said 'Look, Mummy, pretty pussies,' and there at the side of the road was a pride of five lion." That, I quite believe, was true, and I know every effort was made to produce lion for me on the thousands of miles I was taken by the great kindness of my perfect hosts.



At the market of the Bagongwa Tribe.

The trip this day was grand and we were soon passing the crater lakes of Ndali; the road was very fine but narrow and when at one side are crater lakes and at the other away down below are great forests full of elephant, lion and the Lord knows what else, and when you remember that the road is like a knife edge, the driver does not need to be told to keep her eye on the road and she surely did. We only got an impression of the Mountains of the Moon. We came through a long swamp filled with elephant grass and as we approached the clouds cleared considerably and we just got a glimpse of the twin peaks with their snow capped tops. As we went along the road I spotted a large crowd of people in a field; so we drew up and found ourselves in the midst of a most picturesque collection of natives in various states of comparative nudity. They were of the tribe of Bagongwa and this was their market day. They were very friendly and like all the Africans were just as much interested in us as we were in them. We saw all sorts of stuff on sale, notably fried locusts. They very kindly posed for me to take snapshots and I gave them a few coppers and there was a

great scramble on the part of the smaller fry for these. After this we were amused to come on a notice which read "SLOW DOWN FOR THE EQUATOR." So we slowed down expecting that perhaps the line was out of order. Sure enough we came to the equator indicated by two boards, one of which read "SOUTHERN HEMISPHERE" and the other "NORTHERN HEMISPHERE." I stood with the line running between my legs.

We spent some time taking views of the line, and I was interested to see some similar snaps in a weekly paper, but in the meanwhile the indicating



The Equator.

boards had been straightened up a bit. After this we made for the Kezinga Channel, the narrow strip of water between Lake George and Lake Edward which has to be negotiated by boat, as there is no road or bridge. We did not have long to wait and we got the car on without any difficulty and were off again on the other side. Again more crater lakes, and this was the most difficult part of the road, as the razor edge was even more razor edge and the craters were deeper and the forests were darker. Were we afraid? YES! However, we came at last to Mbarara, where we were to stop the night, but not before we had had another thunderstorm, which made it difficult to find our way about. This was perhaps the poorest hotel of our tour. It was run by a Goan. When we went into a very small sitting-room we thought we had hit the jungle by mistake as there was a lion or a panther (skinned) on every chair in the room.

We were off early the next day to make the most distant part of this tour nearly to the border of the Belgian Congo and we knew we had some difficult roads to negotiate. We climbed through miles of mountain passes over a road, the construction of which must have presented untold problems for the engineers, the most prominent of whom was one Came, who is talked of with baited breath, for he must have done really fine work. As I write this some time after on the Indian Frontier I appreciate that here were similar problems, and perhaps the engineers do not get their just recognition for work of this sort.

We travelled along more of the volcanic zones with rough rugged country and I saw two extinct volcanoes; there are, however, eight volcanoes, two of which are still active, but these I did not see owing to cloud. We had a very good view of Lake Bunyoni nestling in the hollow. The area was intensely cultivated and at one place we had what I thought was quite a good cloud of locusts. They were like a thick fall of large snowflakes, but I was assured that this was nothing, and that when there was a complete "black out" then one had seen locusts. At one point on the road we came to some road repairing work going on by natives in a still greater degree of nakedness. They were dressed in bark cloth, and as this did not fit very well, or when the wind was unfriendly, nothing was left to the imagination. As a point of medical interest it was noticed that the men were quite naked under barkcloth, which is unusual in native races. The girls were handsome and again I was fortunate in obtaining a very good picture of two real beauties.

We were climbing nearly all the time and we came soon to the bamboo belt at about 8,700 feet. We descended again to 6,500 feet, which is the height of Kabale, where we were making for. We passed Came's house, an attractive little cottage with one of the most glorious gardens I have ever seen. We stopped. It was empty and not very well looked after and we picked strawberries in his garden. And so we came to Kabale and to the White Horse Inn, which wants a page to itself.

We arrived at the top of the hill to find one of the most delightful places it has been my fortune to get to. The place was built of red brick and heavily thatched with thick elephant grass. It was perishing cold so we were delighted to enter and find a large common room with an enormous wood fire blazing in the open fire place. Presently a lady, dressed in corduroy trousers and a man's coat, appeared. This was the Proprietress, Mrs. Adamson, and a very charming competent woman she was. Mr. Adamson was evidently delicate and did the secretarial work, but Mrs. Adamson was the driving force, and woe betide any servant who did not jump to it. Our rooms were detached from this main portion and were in line; the partitions were not very thick, so if one wished to communicate with the person in the next room but one, then one just raised one's voice a little more. They were comfortable rooms and we spent a good night and had excellent food and drink. I can heartily

recommend the White Horse Inn. Mrs. Adamson, as a sop to convention and perhaps as a compliment to me, appeared in a different pair of trousers at night and with a black coat. Down country I am told she was *le deniere cri* in gowns. The morning was glorious looking up the grand valley towards the Congo, and with the mists gently rising from the warming ground being twisted into wisps by the gentle breeze the picture was one of sheer joy, and we left it with regret to turn homewards once again. I should mention that we received hospitality from Dr. and Mrs. Burton, who were stationed here. This was evidently a grand place to be stationed, for living was cheap apart from imported stores. I was told one could buy a sheep for half-a-crown, and this was the method of shopping in the cold weather, when one bought the sheep on the Friday and had it in various forms, certainly until the following Wednesday. It was Dr. Burton who very kindly took us a bit further along the road towards the frontier.

We made an early start and returned partly by the way we had come, as far as Mbarara, and then by a different route making east towards the lakes. This route took us through miles and miles of what I had almost imagined must be typical African scrub jungle—bush, and if ever during my tour I ought to have seen lion it was in this bit. Actually we saw very little game of any sort. We ultimately arrived at the Kiwala Hotel, Masaka, which was owned by a very nice and capable woman, Mrs. Keble. This hotel overlooked Lakes Nabugabu and Victoria, and in the far distance we could see Entebbe and Kampala, but we were in no particular hurry and so the morrow would do for our inspection. This was a bigger hotel in a lovely compound, and everywhere flowers were in great profusion. I met a white hunter here who would have been ready to arrange for a lion or an elephant, but unless one is living at a farm or some such place and sits up, that is an expensive affair as the hunter is paid by the day and naturally is not keen to walk up a lion the first day. The charges vary with the part of the country, but the usual charge is £2 or £3 per day and all expenses, and hunters are seldom teetotal.

(To be continued.)

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## Current Literature.

BOARD OF EDUCATION. EDUCATIONAL PAMPHLETS, No. 109. **Physical Education in Germany.** 80 pp. 1937. London : H.M.S.O. [1s.]

Nine British educationists inquiring into physical training had the practical aspects of the present German ideals demonstrated during a ten days' visit, and present their impressions.

Education in each of the Provinces is under a director representing the central Ministry. Under him is a department for physical education of which a deputy is chief organizer and inspector.



For a couple of generations all large elementary schools have had a gymnasium of about 40 by 80 feet, and this is now regarded as standard. Weekly exercises for 45-minute periods are the rule, and now a daily lesson is advocated. As yet no standard syllabus has been issued. Heavy muscle training seems commoner than in England, and free standing exercise is mostly replaced by lifting, throwing, running, and jumping. Apparatus work seems ill-balanced, over developing the upper part of the body. The large medicine ball is much used to great advantage. Courage training, and work for the team—which represents the State—is always inculcated.

In passing from primary to secondary schools a qualifying examination is required, and physical are as necessary as academic attainments. Careful records are kept and some biological research is being followed. Through this Report standards of accomplishment for age are tabulated.

All teachers must have systematic physical training as a major accomplishment, and much is to be said for this. Those going into secondary schools must take it as one of their three selected subjects in the University course. If they specialize, an extra year is needed in a special Institute. They are then qualified for transfer in later years to ordinary academic work.

A new feature of training is the residential National Political (Napoli) school. These schools are directly under the Minister of Education. The head of such a school is free from external control and more independent than any other German teacher. The Hitler-Youth looks out for boys about ten years old, as probable leaders. Each is investigated physically and mentally, and finally given a week of observation in the school. Selection is severe, it is action which counts. Each wears a brown uniform with swastika. The masters' uniform is that of the brown shirts storm troops. By 14 years of age the boys must pass the first Hitler Youth tests, as detailed. They then go to sterner work, mountain, air, land and sea, whilst following the ordinary academic courses. Class distinctions are lost, broken in six months' intermission in industrial or agricultural work, away from the school, where each one lives with the ordinary workers. They flourish and are happy and pleasant as a result of this régime.

In the Universities physical training is given a place as important as any academic learning. A student failing to obtain the requisite number of marks on his card, must repeat the course ere his advance in other subjects is allowed. Specialists must go for an additional year to a special Institute, which also provides refresher and finishing courses for others. Details of the various requirements for admission include proof of Aryan descent, and physical and moral suitability to German standards.

The apex of this work is the Reichsakademie in Berlin, which embodies in its medical, biological, pedagogical, technical, practical, and administrative departments with seven gymnasiums, elaborate equipment for research, and a great library of its subjects. It can accommodate 500 residents.



By these observers the free standing exercises were wanting in precision and style. Athletic technique is more valued in Germany than in England. Frequent singing imparts an emotional uplift which prevents the dulness of so much of our work. The windows high in the walls and overheated stuffy ventilation was noticed, otherwise the æsthetic impression given was excellent.

Other arrangements discussed are the semi-official National Training League (Reichsbund) corresponding to what seems intended for Britain in recent legislation; and the National Sports Field at Berlin, possibly the greatest sports arena that has ever existed.

The Hitler-Jugend (Hitler-Youth) established as a feeder for the brown shirts, has been developed by suppression of scouts and wanderers associations, and is now effectively organized on a military basis with all the panoply that appeals to adolescent emotions. Its narrow and intensive propaganda conscripts German youth as serious and selfless units of the State. Efficiency tests (detailed) are prescribed for each year of age, and it constitutes an immense reservoir for the Reichswehr.

The Land Year Scheme gives an invaluable orienting time for adolescents who live and work with the peasants [and seems most worthy of emulation in Britain]. The Labour Service takes annually nearly half a million from 18 to 25 years of age and breaks them in by a year of useful communal work at a daily wage of about 2½d.

The Siemensstadt described is a magnified form of the social care of many British firms for their workers. It cares for 61,000 workers. Efforts to introduce short periods of gymnastic and recreative exercise between working hours failed; but the apprentice schools taking about 250 to 300 boys of 14 years old for four years has been a splendid success.

The great popular movement "Kraft durch Freude" (Strength through Joy) in which all Germans of Aryan descent may participate, is a well-organized social control of everything that makes for physical welfare.

Germany has little use for the unfit; intellectual wasters are unnecessary. They want people good to look at, and capable of doing things. This is the modern standard, all else is out of date, and Germany is prepared to pay for it. The warning to academic education which this brochure conveys is urgent, and necessary for all who govern.

JAMES KERR.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

FARAGÓ, F. and ERDÖS, L. Ueber den Wert der Dick-Reaktion auf Grund epidemiologischer Beobachtungen. [On the Value of the Dick Test in Epidemiological Investigation.] *Ztschr. f. Hyg. u. Infektionskr.* 1937, v. 119, 660-66, 3 figs. [12 refs.]

Between January, 1936, and February, 1937, 17,480 Dick tests were carried out in 19 different areas in Hungary. The Washington Standard toxin was used. The results obtained were compared with those of 17,000

tests carried out by Johan in 1926. Curves obtained in the different places recording the percentage Dick-positives of various ages could be divided rather characteristically into three groups: (A) pre-epidemic, (B) epidemic, and (C) post-epidemic. In group A the percentage positive averaged 50·3; in group B 36·9, and in group C 25·4. There is thus a close relationship between the prevalence of scarlet fever and the total number of Dick-positives and also between prevalence and the average percentage Dick-positive. Whatever the deficiencies of the Dick test as a guide to individual susceptibility, it is a useful index of the degree of immunity of a population to scarlet fever. C. C. OKELL.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

DAVIS, D. J. **Bovine Mastitis in Relation to Milk-borne Epidemics.**  
*J. Infect. Dis.*, 1937, v. 60, 374-80, 3 figs.

By smearing streptococci from separate sore throat cases on the teats of a cow, if the teat was slightly scarified about the meatus the streptococci ascended into the udder, causing a mastitis lasting for a long time. There was, however, very little local reaction, and no evidence of extensive tissue involvement. The author quotes positive results by other workers along the same lines but without any scarification. He discusses in some detail the histology of the teat and its canal. Experiments with teats immersed in carbolfuchsin and then manipulated as in milking showed that in all fifty-six teats tested in none did the dye ascend through the teat into the cistern. The maximum penetration was 4 mm., and this was associated with scars or other defects at the meatus. With extensive manipulation and defects, such as scars, penetration in this way cannot be entirely ruled out. In mastitis cases there is no evidence of inflammatory changes along the teat duct. Defects of the teat may, however, predispose and possibly lead to infection.

In cases of experimental infection of the udder with streptococci introduced through the teat there may be little evidence of parenchymatous change in the udder or there may be violent reaction with severe generalized infection of the udder quarter. This was the case in the udder of a cow, the milk from which caused an outbreak of 260 cases of human sore throat, the post-mortem being made about three months after the epidemic. In one quarter there had been an acute mastitis, while in another quarter abundant growth of hæmolytic streptococci was obtainable from the milky fluid exuding from the gland. Somewhat similar results were obtained from a second cow in which a violent mastitis resulted from simple implantation of streptococci on the teat.

With five cows, the teats of which were freely and frequently swabbed with staphylococci of human origin, no evidence of any infective mastitis resulted. When in two cows the staphylococci were introduced about  $\frac{3}{8}$  inch up the teat, in one mastitis resulted with abundant staphylococci in the milk. W. G. SAVAGE.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

JENSEN, C. **Acute Immunization against Diphtheria by the Combined Subcutaneous and Intranasal Method.** *Proc. Roy. Soc. Med.* 1937, v. 30, 1117-48 (Sect. Epidem. & State Med., 71-102), 19 figs. [30 refs.]

This is a comprehensive and authoritative review of the methods of active immunization against diphtheria by the Director of the Department of Biological Standards, Copenhagen. In particular the author gives a full account of the technique used and the results obtained by the combined subcutaneous and intranasal method of immunization. Most of the immunization work recently carried out in Denmark and elsewhere under Dr. Jensen's advice has been checked by actual antitoxin titrations of the sera of the immunized children. The author describes his numerical methods for using the figures so obtained for evaluating mass immunity. The immunizability of a population is directly correlated to the number of its individuals possessing antitoxin and also depends to some extent on the magnitude of this natural antitoxin. A good expression of the immunity and immunizability of a population may therefore be obtained by grouping its individuals according to the titres found in blood samples before immunization. The following grouping is suggested. Individuals with (1) less than 0.0005 unit per cubic centimetre serum; (2) more than 0.0005 unit but less than 0.01 unit; (3) more than 0.01 unit but less than 0.1 unit; (4) with 0.1 unit or more. On this principle spectrum-like block diagrams may be constructed which show the immunity and immunizability of a population in graphic form. We may accordingly speak of the natural or primary antitoxin spectrum of a population as expressed by the distribution of natural antitoxin in the group at the time the primary blood samples are taken, and the artificial or secondary antitoxin spectrum which expresses the immunity of the group after artificial immunization. The author then proceeds to give the results of immunization with an inoculation of  $\text{Al}(\text{OH})_3$  toxoid; a single injection of a medium-sized dose of this antigen resulted in 90-99 per cent immunity with a minimum of ill-effects. With a view of improving on these results a method of combined subcutaneous and intranasal immunization was investigated with very good results. A single dose of  $\text{Al}(\text{OH})_3$  toxoid is given followed by nasal instillation of toxoid. The nasal treatment has been generally carried out by the mother of the child. [A very complete and detailed description is given of the combined method as it has been used in Denmark].

C. C. OKELL.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

## Reviews.

---

**THE OPERATIONS OF SURGERY.** By R. P. Rowlands, M.S.Lond., F.R.C.S.Eng., and P. Turner, B.Sc., M.S.Lond., F.R.C.S.Eng. Eighth Edition. Vol. II. London: J. and A. Churchill, Ltd. 1937. Pp. ix + 998. Price 36s.

This second volume comprises Abdominal Surgery. Mr. W. H. Ogilvie has revised and rewritten the chapters on the preparation of the patient, operations on hernia, the spleen, the pancreas, the anus and rectum.

Mr. A. P. Thompson has rewritten and revised the chapters on the genito-urinary system, and Mr. G. F. Gibberd the sections on gynæcological operations. The last chapter deals with recent developments in surgery.

These two volumes are as clear and helpful an account of the standard operations of surgery as can be found anywhere, the illustrations are excellent and the authors and revisers are to be highly congratulated on the production of a first-class and indispensable contribution to surgery.

J. W.

**CHRONIC RHEUMATIC DISEASES:** being the Third Annual Report of the British Committee on Chronic Rheumatic Diseases appointed by the Royal College of Physicians. No. 3. Edited by C. W. Buckley, M.D., F.R.C.P. London: H. K. Lewis and Co., Ltd. Pp. x + 132. Price 10s. 6d. net.

Those who are interested in this subject will find in this volume and its two predecessors almost everything that is known concerning the ætiology, clinical aspects, pathology and treatment of chronic arthritis. In the opening chapter, which deals with the treatment by vaccines, Okell does not agree that the streptococcal cause for rheumatoid arthritis has been proved, and he has doubts regarding the efficacy of the administration of a vaccine made from a micro-organism for a supposed infective disease when there is no acceptable evidence that the disease is caused by the micro-organism in question. The allergic effect of streptococcal infection is also difficult to establish. In J. R. Learmonth's chapter on the treatment by sympathectomy, it is learnt that this operation relieves the pain in early cases and transforms the cold, clammy hands in certain cases into warm dry ones. The operation is advised for selected cases only and a short description of the operation is given.

Gunnar Kahlmeter, of Stockholm, summarizes the X-ray treatment as a most valuable agent, its effect being best in acute cases of gonorrhœal and septic arthritis, septic bursitis and all forms of tendinitis, and for the relief of perivascular symptoms of rheumatoid arthritis. The results appear to be best in the following order in a descending scale: shoulders, knees, foot-joints and toes, fingers and wrists, the latter being very resistant.

The relation between vitamins and rheumatic diseases is discussed by

J. Race of Buxton, from which we learn that, in rheumatoid arthritis especially, the blood serum contains less carotinoid pigments and vitamin A than usual and also less vitamin C. A deficiency in vitamin B is probable but has not been demonstrated. Prophylactic and therapeutic studies on the effect of vitamin C have been abortive.

The leucocyte response in the rheumatoid type of arthritis is reviewed by D. H. Collins of Leeds and he gives an account of two cases of neutrophil leucopenia with enlargement of the liver and spleen in rheumatoid arthritis.

This volume also contains reviews and summaries of various forms of therapy such as Diet in Arthritis, by C. W. Buckley; Recent work in Osteo-arthritis, by Osmond Clarke; and Chrysotherapy, by W. S. Tegner. Watery solutions are, on the whole, preferred to oily ones and the contra-indications in the treatment by gold are mentioned. A. A. Moncrieff is responsible for the review of mineral metabolism and the reticulo-endothelial system in relation to joints. G. H. Jennings prefers to treat gout by the administration of eighty grains daily of sodium salicylate rather than by amidopyrin and cincophen. The dangers of the latter are reported upon by H. E. Archer and G. Discombe. The synopsis of recent American investigations on diseases of joints and related structures is ably dealt with by P. Hench, at the end of which an excellent bibliography is given.

The report is brought to a conclusion by abstracts and reviews from continental journals by F. J. Bach and G. C. Pether. In each section many references are given to assist the reader. The type is beautifully clear and the index is sufficient.

R. C. P.

POCKET ATLAS OF ANATOMY. By V. Panchet and S. Dupret. Third Edition. Humphrey Milford, Oxford University Press. Pp. xiv + 368. 12s. 6d. net.

This little book, which measures only 7 by 4½ ins., will be found of use by those who wish to refresh their knowledge of anatomy.

It is not intended for first-year medical students, as it contains no letterpress, but consists entirely of diagrams—345 in all. These are for the most part in black and white, but two shades of red are used in some of them.

In addition to the more usual diagrams, there are several drawn from an unusual angle, such as the pharynx and adjacent structures viewed from behind. Nothing appears to have been left out, and this probably accounts for the one defect of the book. It is tiring to study. The multiplicity of names at the sides with dotted lines, coupled with the lack of contrasting colours and often small size of the drawings makes for difficulty.

The book would be improved by fewer and larger plates with additional colours.

The nomenclature employed is that adopted by the Anatomical Society in 1933.

C. M. F.

**WHAT IS OSTEOPATHY?** By Charles Hill, M.A., M.D., D.P.H., and H. A. Clegg, M.A., M.B., M.R.C.P. London: J. M. Dent and Sons, Ltd. 1937. Pp. xx + 217. Price 7s. 6d. net.

The authors of this book are good sportsmen. They have produced a good clean "kill" of the whole idea of osteopathy and State registration of osteopaths.

They give what credit is due to osteopathy for those conditions in which movement does good.

To the lay mind osteopathy is a science neglected by the medical profession and it is just as well to be able to produce real facts and arguments to defeat this idea.

This book will repay reading, as the whole myth of osteopathy is fully and clearly exposed.

R. G. A.

**FAILURE OF THE HEART AND CIRCULATION** (Pocket Monographs on Practical Medicine). By Terence East, M.A., D.M., F.R.C.P. London: John Bale, Sons and Curnow, Ltd. 1937. Pp. viii + 130. Price 2s. 6d.

The author states this little book is an attempt to explain in a simple way what happens in the circulation when the heart fails. He has succeeded in an admirable way in producing a most interesting, lucid and complete account of heart failure, its mechanism, treatment and prevention.

The causes of ventricular failure is first considered and then the effects of this breakdown on the cardiac output, the blood flow and venous pressure.

A chapter is devoted to a consideration of the secondary effects of cardiac failure on the function of various organs. The differentiation of right and left ventricular failure is discussed. Treatment is fully dealt with and the relative value of the various preparations of digitalis and strophanthus are discussed.

This book is strongly recommended to all those who are interested in cardiology.

A. G. B.

**MODERN TREATMENT IN GENERAL PRACTICE.** Vol. III. Edited by Cecil P. G. Wakeley, D.Sc., F.R.C.S., F.R.S.E. London: Baillière, Tindall, and Cox. Pp. xii + 436, with 54 figs, size 6 x 8½. Price 10s. 6d.

This, the third volume, contains articles giving the treatment for no less than fifty-one conditions that are met with in general practice and to select any one of them for special remark or review is impossible. In our opinion the treatments set forth are so up to date and so accurately and

clearly expressed that busy practitioners at home and abroad who have no access to libraries or clinics owing to pressure of work or to distance, should avail themselves of the invaluable help and sound advice that is to be found in this work. The book is of convenient size and the print is clear. There are one or two typographical errors which in no way detract from its value.

The figures and illustrations are clear and well produced and each volume has its own index.

L. C. P.

ILLUSTRATIONS OF REGIONAL ANATOMY. By E. B. Jamieson, M.D.,  
Sections I to V. Second Edition. Edinburgh: E. and S. Livingstone.  
1937. Price 32s. 6d.

This work consists of seven sections. Nos. VI and VII are devoted to the upper and lower limbs and, as they were not published until the autumn of 1936, they are not included in the second edition under review.

Each section consists of anatomical drawings encased in a loose-leaf cover. There is no letterpress nor alphabetical index. The names of structures are printed at the side with leader lines. The nomenclature is that adopted by the Anatomical Society in 1933.

This is a bald statement of the scope of the work, but one which falls far short of doing it justice. The illustrations are numerous and beautifully drawn. They are large enough to be perfectly clear, although each section can be slipped into an overcoat pocket.

Colours have been used in most cases, as many as six being employed. The paper is good and the printing clear. Altogether it is an excellent book and one which can be confidently recommended to anyone who wants rapidly to brush up his anatomy or add to his knowledge of the details of the more obscure regions of the body.

C. M. F.



## Correspondence.

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### AURAL REQUIREMENTS OF THE REGULAR ARMY.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—As a battalion medical officer for fifteen months in the field during the War, my experience is that a man with a potential ear discharge is useless in a front line unit.

Major Waggett states that "old perforation cases *under exposure* will from time to time show a discharge." This is the very type of man who is not wanted in a fighting unit. He breaks down at a critical time and clogs evacuation. A battalion may be constantly on the move by day or night, and such a man is only suitable for lines of communication or base units.

I am, etc.,

Citadel Military Hospital,  
Cairo.

W. S. EVANS,  
Major, R.A.M.C.

November 27, 1937.

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## Notice.

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FOUR booklets have been received from Boots Pure Drug Co. Ltd. (Nottingham). The first deals with Protamine insulin (with zinc) in the treatment of diabetes mellitus. It describes the use of this product and gives suggestions as to its employment in mild and severe cases of diabetes mellitus, with particulars of dosage and diet. The new protamine insulin (with zinc) is issued in suspension in water in two strengths—40 units per cubic centimetre, and 80 units per cubic centimetre. Cases of diabetes of moderate severity can usually be controlled by one injection of protamine insulin (with zinc) suspension a day, given before breakfast. In more severe cases of diabetes it may be necessary to employ a mixture of this new product with insulin given at the same time or later in the day.

The second, Ovarian Hormones in Clinical Practice, gives particulars of new products, Ovostab (œstradiol benzoate), and Luteostab (corpus luteum hormone), together with suggested dosages, and indications for their use.

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Sulphanilamide (Boots).—A stable preparation for the oral treatment of hæmolytic streptococcal and other bacterial infections.



### EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

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Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed— "The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."

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Original Communications.

THE COLIFORM BACILLI AND WATER SUPPLIES.

BY MAJOR E. F. W. MACKENZIE, O.B.E. M.C.,

AND

MAJOR F. C. HILTON-SERGEANT.

*Royal Army Medical Corps.*

(Continued from p. 25).

VI.—EXPERIMENTAL WORK.

In considering problem (I), whether any one easily recovered organism is constantly present either alone or in conjunction with others, *Bact. coli* type I appeared to be the organism most likely to provide the answer. Bardsley (1934) failed to recover this organism from two of thirty-two samples of fæces examined by the usual plating methods, but it was considered that this small percentage of failures might well have been due to the technique used and that the modified Eijkman test might so facilitate its recovery that it would be found to be present in 100 per cent of human fæces.

*Bact. coli* type I was therefore selected as the organism most likely to prove to be a satisfactory indicator, particularly since the recovery of this organism is greatly facilitated by the modified Eijkman test.

The following technique was followed in the examination of samples of fæces from 100 different individuals. A spot of fæces was inoculated into peptone water and incubated at 37° C. for four hours. This culture was then inoculated into 10 millilitres of MacConkey broth at 44° C. and incubated at this temperature in a water bath. Readings were taken at

eighteen and forty-eight hours. The presence of acid and gas was considered to be a positive reaction.

A positive reaction was present in 100 per cent of cases in eighteen hours.

Complete identification of the organism bringing about a positive result in any particular case did not appear to be essential to the object in view since Wilson *et al.* (1935) found that of 496 strains of coliform organisms examined, a positive Eijkman resulted from organisms other than *Bact. coli* type I in only 2 per cent of cases.

Nevertheless a limited number of confirmatory tests was carried out by selecting tubes at random for further examination. Each selected tube was plated and from two to five colonies of differing appearances were selected. Fifty-five such colonies were investigated, all of which proved to be *Bact. coli* type I, as indicated by the following criteria: motile, Gram —, lactose +, M.R. +; V.P. —, citrate —, indole +, Eijkman +.

It would thus appear that *Bact. coli* type I is constantly present in human fæces and that its presence may be detected in 100 per cent of cases by the Eijkman test alone.

Fifty-four colonies isolated from tubes of MacConkey broth prepared as above described but incubated at 37° C. were also investigated. In all cases these proved to be *Bact. coli* type I. No *aerogenes-cloacæ* or intermediate types were recovered.

Bardsley (1934) investigated 220 colonies by direct plating from emulsions of thirty-two samples of fæces and recovered non-fæcal types as follows: *aerogenes-cloacæ* from 9 per cent of samples, intermediates from 16 per cent, irregulars from 6 per cent.

Of 125 strains isolated from fifty samples of cow dung by Wilson *et al.* (1925), 91·2 per cent were *Bact. coli* type I. The remaining 8·8 per cent was constituted as follows: *Bact. coli* type II 1·6 per cent, coli-like irregulars 5·6 per cent, *Bact. aerogenes* type I 1·6 per cent.

In view of the comparative scarcity in fæces, either human or bovine, of organisms of the coliform group other than *Bact. coli* type I it is clear that unqualified acceptance of the indications of the "presumptive coli" test is tantamount to permitting convenience and established practice to drive us in a direction contrary to that indicated by recently established facts.

The investigation described above is open to the criticism that the broth was somewhat heavily inoculated, and that, had this not been the case, the organisms might not have been recovered from 100 per cent of samples. Moreover, it might not be so easily recovered from water, in which it would be present in smaller numbers. Wilson *et al.* (1935) showed that *Bact. coli* is recovered at least as readily at 44° C. as at 37° C. and, for reasons set forth elsewhere, there appears to be no doubt that the isolation of *Bact. coli* type I subsequent to incubating at 44° C. is more certain than by selecting colonies from plates prepared after incubating in MacConkey broth at 37° C.

Nevertheless tests were carried out to ascertain in what dilutions of fæces a positive result might be expected from the "presumptive coli" test and from the Eijkman test.

Fæces were emulsified in sterile water and dilutions ranging from 1 : 1,000,000 to 1 : 10,000,000,000 w/v were put up in 10 millilitre quantities in MacConkey broth in duplicate sets. One set of tubes was incubated at 37° C. and the other set at 44° C. The results of this test are shown in Table III.

TABLE III.

		1 : 10 <sup>-6</sup>	1 : 10 <sup>-7</sup>	1 : 10 <sup>-8</sup>	1 : 10 <sup>-9</sup>	1 : 10 <sup>-10</sup>
37° C. ..	..	A. & G.	A. & G.	A. & G.	Neg.	Neg.
44° C. ..	..	A. & G.	A. & G.	A. & G.	Neg.	Neg.

It will be seen that in both cases a positive result was obtained in a dilution of 1 : 100,000,000, while dilutions beyond this were negative.

The Eijkman test, therefore, as an indicator of recent fæcal pollution, is no less sensitive than the "presumptive coli" test.

The results obtained warrant the assumption that *Bact. coli* type I is constantly present in human fæces and that, when recent human fæcal pollution is present in water, it may be detected by the Eijkman test alone with at least as great a degree of accuracy as by any other known test.

As regards problem (II), Gray (1932) confirmed the findings of many others to the effect that the intestinal pathogens do not outlive *Bact. coli*. This author has been selected for reference since he used fresh strains in infective fæces. By so doing he avoided the fallacies liable to result from the use of cultured organisms, a procedure adopted by many investigators.

## VII.—CONCLUSIONS.

In view of the above findings it would appear that it matters not whether coliform types other than coli I are, or are not, present in a water in so far as an immediate opinion on the water is concerned since, if their presence is due to recent fæcal pollution, they will be accompanied by coli I.

It should be emphasized that it is not suggested that the information given by the "presumptive coli" test is no longer of value in routine control of water supplies. Such a proposal could not be justified by the available evidence. It is, however, suggested that the chief value of the test lies in its ability to detect any increase in the number of organisms of the coliform group since this, though not in itself indicative of dangerous pollution, may be accepted as denoting some change in conditions from which dangerous pollution may result. The "presumptive coli" test may, if the organisms bringing about a positive result are fully investigated and fæcal coli are shown to be present, be the preliminary step in demonstrating fæcal pollution, but this may be demonstrated more rapidly and with greater certainty by other methods.



Opinions regarding the reliability of aerogenes and non-fæcal coli as evidence of remote pollution vary. Bardsley (1934) found that, in England, non-fæcal types in water are, in the majority of cases, associated with fæcal types and considered the precise identification of the organisms causing the positive "presumptive coli" test unnecessary. This is not in accord with our observations, nor with those of observers in America and in tropical countries.

In those countries where lactose fermenters abound in the absence of excretal contamination, the "presumptive coli" test alone is misleading and if used should invariably be followed by complete identification.

Ministry of Health Report (1936) prescribes the following five differential tests for the routine identification of the organisms of the coliform group concerned in a positive "presumptive coli" test—M.R., V.P., indole, citrate and liquefaction of gelatin. The M.R. test is closely correlated with the gas ratio and is more conveniently performed; the latter test is therefore omitted. Liquefaction of gelatin might also have been omitted since the value of a test in water analysis depends upon the light it sheds on the origin of the organism concerned; this test does no more than separate cloacæ from aerogenes, each of which has a similar significance. Moreover, the fact that the test cannot be read for seven to ten days renders it of little value other than for purposes of record or systematic classification.

Report (1936) does not allot to the modified Eijkman test the important rôle which it seems likely to fill in the future.

Prior to the introduction of the modified Eijkman test the minimum number of tests which might be considered essential was four, namely M.R., V.P., indole, and citrate. These are the differential tests recommended in Standard Methods (1936). The performance of these tests occupies six days and a final opinion regarding the significance of the organisms present in a water could not be expressed in less than that time.

The problem thus resolves itself into whether or not the bacteriologist can give the sanitarian the information he requires in a shorter time.

The "presumptive coli" test has, up to the present, been universally employed for this purpose.

In those localities in which the non-fæcal coliform organisms abound outside the mammalian intestine this test is rarely negative and, unless supplemented, has little or no significance when positive. Its unqualified acceptance leads to the condemnation of large numbers of wholesome sources of supply, and for reasons to be advanced later, its adaptation to local conditions has been unsuccessful. It is easy to lay down standards which will ensure absolute safety. It is more difficult to decide what measures may be discarded with safety in an endeavour to meet the demands of circumstance, and there is a strong body of opinion to the effect that arbitrary numerical standards applied to the presumptive test are of no value in the tropics.

A great organization delivering water to a large number of consumers is in a position to carry out every known test which may throw light on the past history and therefore on the possible future state of the water. The controllers thereof would incur grave responsibility did they not do so. Many, on the other hand, are placed in the position of having to form an opinion on a source of water in a time which precludes the accepted routine. In these circumstances the usual procedure of the bacteriologist, since he so frequently has no alternative, is to furnish the sanitarian with the result of a "presumptive coli" test, frequently positive in small quantities. The unfortunate sanitarian may have no previous bacteriological analyses for comparison, even no standards applicable to the locality. He can find no visible source of pollution, yet he dare not ignore the bacteriological findings. Only a courageous man, or perhaps a foolhardy one, would accept a water under these circumstances and it is consequently condemned.

The modified Eijkman test provides the possible solution of this problem. If the MacConkey broth be inoculated directly with the sample, a positive result may be obtained in eighteen to twenty-four hours. Wilson *et al.* (1935) found that positive results were 10 per cent higher at forty-eight hours than at twenty-four hours and our experience confirms this. A negative result should be recorded, therefore, only after forty-eight hours' incubation.

In the following paragraphs an endeavour is made to assess accurately the significance of the Eijkman test.

The organisms belonging to the coliform group identified by Wilson *et al.*, which give a positive Eijkman test, are *Bact. coli* type I and irregulars II and VI. Of 496 strains investigated after discarding duplicate strains from the same sample, 9 were found to be irregular type II and 1 to be irregular type VI. The typical habitat of type II is doubtful. The one strain of type VI isolated was non-fæcal in origin. The percentage of false positives which might arise from the presence of coliform organisms other than fæcal *Bact. coli* type I is therefore negligible. Our experience has been that *Bact. coli* type I has invariably been recovered from tubes giving a positive Eijkman result.

A positive result therefore signifies, at the least valuable assessment of the test, that the water is under grave suspicion of recent excretal contamination.

The value of a negative result is vastly more important and somewhat more difficult to assess.

Irregular type I is the only Eijkman negative member of the group which has any claim to be typically fæcal in origin. Of the 496 strains isolated only 13 were of this type, and its importance is therefore slight. The authors have demonstrated moreover that, if present, it is, at least in England, invariably accompanied by Eijkman positive strains in sufficient numbers to justify a claim that a negative Eijkman indicates the absence

of fæcal coli and consequently that any pollution which may have existed is sufficiently remote for the fæcal coli, and with them the intestinal pathogens, to have died out.

Admittedly a negative "presumptive coli" test in comparatively large quantities is stronger evidence of complete absence of pollution, but when, as is so often the case abroad, arbitrary standards such as "absent in 10 millilitres" are necessitated by the frequent occurrence of coliform organisms unassociated with dangerous pollution, there exists no guarantee that the organisms producing the positive reaction in the next larger quantity may not be fæcal coli. When plating of the positive tubes is resorted to it is not unlikely that fæcal coli, though present, may be overgrown to such an extent that they are missed in the selection of colonies for further examination, whereas they would have been readily detected by the Eijkman test. In England also the high standards applied to the "presumptive coli" test in the case of municipal water supplies are not infrequently set aside in the case of small supplies.

In the above circumstances a negative Eijkman indicates the absence of dangerous pollution with greater certainty than does a "presumptive coli" test carried to its logical conclusion and found not to be caused by fæcal coli.

Castellani (1910), Clemesha (1912 A, B), and many others have shown that the intestinal flora may vary with climate and locality, and further investigation is therefore necessary. Nevertheless it seems reasonable to suppose that ability to grow at 44° C. may be due to the higher temperature in which the fæcal coli find their natural habitat as compared with the non-fæcal. If, as there seems no good reason to doubt, further investigation abroad yields results parallel to those obtained in England, we have here a test likely to be of peculiar value under conditions which prevail in the Services, and one which will greatly facilitate the bacteriological examination of water supplies by small or mobile laboratories.

In the routine control of established water supplies also, it may be considered an indispensable adjunct to the usual tests in that it has the following advantages:—

(a) It facilitates the isolation of fæcal coli if present in small numbers since, when other methods are used, they may be overgrown, diluted out, or missed when selecting colonies from plates.

(b) The advent of fæcal coli, or an increase in the numbers present, can be ascertained in a time impossible to achieve by any other means.

(c) The method suggested by Wilson *et al.* (1935) by which all tubes which give a "presumptive coli" reaction are subcultured directly into MacConkey broth incubated at 44° C. and into tubes of Koser's citrate medium incubated at 37° C., enables us to separate the responsible organisms into fæcal and non-fæcal coliform groups, and to estimate the ratio of one to the other in the shortest possible time.

It would thus appear that a strong case exists for performing the

Eijkman test in all laboratories in any way concerned with the bacteriological examination of water supplies, both from its known value and in order to ascertain definitely its degree of correlation with the known sanitary quality of water supplies as indicated by other tests and by a knowledge of the source. There is reason to believe that extended trials would enable numerical standards to be laid down with a confidence which has long ceased to be associated with the presumptive test.

Wilson *et al.* (1935) have set forth a vast amount of evidence in favour of the validity of the test in milk analysis, and Dodgson (1937) lays down standards which he considers provide a legitimate criterion of pollution in the case of shell-fish.

It seems probable that the test may also have a wide application in the examination and control of swimming bath water. Bardsley (1934) found aerogenes to be most abundant in samples of swimming bath water, all of which had been treated with chlorine and which contained a residuum usually between 0.2 and 0.5 p.p.m. She attributes their predominance under these conditions to their resistance to chlorine. Difficulty was experienced by her in the recovery of *Bact. coli* and it was often necessary to plate out every positive MacConkey tube to recover it. In routine work it would have been reported as absent.

In the case of swimming bath water an extensive trial of the test and an endeavour to lay down standards is therefore indicated.

#### SUMMARY.

A summary is given of the tests hitherto employed in routine bacteriological examination of water supplies with a brief outline of the advantages and limitations of each test. The conclusion is reached that in cases where a single examination only is possible and the time for its performance is limited, the only test of practical value has been the "presumptive coli" test. Attention is drawn to the limitations of this test and the consequent increasing frequency with which the sanitarian demands the further identification of the organisms responsible for a positive presumptive test is noted.

An answer is sought to the question "Are the coliform bacilli present in the water of excretal origin, and therefore indicative of recent dangerous pollution, or are they not?" The means available as aids to providing this answer are discussed.

A brief historical résumé of the classification of the coliform group of organisms, together with the means employed to this end, is given. This is followed by a summary of recent authoritative work on the subject and the ecology of the various types of organisms included under the omnibus term "coliform" is discussed. It is submitted that the problem which requires elucidation is not whether this or that organism may or may not be found in faeces, but whether there is constantly present in faeces any one organism which can be identified by a simple and rapid test. Such

an organism, if present, would serve as an indicator of recent faecal pollution, and if absent would indicate the absence of dangerous pollution provided its longevity in an unfavourable environment be greater than that of the intestinal pathogens.

Evidence is produced in support of the claim that *Bact. coli* type I complies with these demands, and that it can be recovered more readily by the Eijkman test than by any other known method.

A plea is made for extensive trials of the Eijkman test, which is considered to be of peculiar service both under conditions which prevail in the Services and in the routine control of established water supplies.

#### THE MODIFIED EIJKMAN TEST.

This test, as originally devised by Eijkman (1904), consisted of the formation of gas in a glucose broth medium incubated at 46° C.

The original medium was subsequently modified by Williams *et al.* (1933).

The test has recently been investigated by Wilson *et al.* (1935), who produce ample evidence in favour of further modification. Their modifications are embodied in the following suggestions from Topley and Wilson (1936).

(1) The success of the test depends upon the exact adjustment of the temperature of the medium itself to 43° to 45° C.

(2) The only satisfactory means of ensuring this is to incubate the tubes in a constant temperature water-bath.

(3) The value of the test is enhanced by replacing the modified Eijkman glucose broth by MacConkey's lactose bile salt broth.

The following procedure has been adopted by the authors and has proved satisfactory.

The MacConkey broth is prepared and tubed off in the quantities required.

The constant temperature water-bath is adjusted to maintain a temperature of 44° C. in a control tube of broth, which is kept in the bath.

The water under test is inoculated into appropriate tubes of broth, the temperature of which has previously been raised to 44° C. in the water-bath. This minimizes the time-lag in obtaining the correct temperature in the medium after inoculation.

The temperature in the control tube of broth is checked before and after the incubation of each series.

A preliminary reading is taken at eighteen hours and a final reading at forty-eight hours.

A constant temperature water-bath convenient for the purpose was manufactured by Messrs. Baird and Tatlock to our specification, which was as follows :—

A rectangular copper bath electrically heated with thermostatic control. Internal dimensions, 15½ in. by 12 in. by 10 in. deep.

A perforated metal container (on four legs and provided with two

folding handles), size  $13\frac{1}{2}$  in. by 9 in. by 8 in., divided into six compartments. Removable metal lid provided with a thermometer.

Each compartment is capable of holding a standard test tube basket of  $5\frac{1}{4}$  in. by  $3\frac{1}{4}$  in. by  $3\frac{1}{4}$  in., which may be made of tinned copper or other non-rusting material.

The water in the bath should be kept at a level just above that of the medium in the tubes.

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“BAJILLED.”

By AL GEBELI.

(Continued from p. 37).

III.

The freedom to move about under slave escort was suddenly withdrawn on the arrival of Moh'd Zaid, Sheikh of Obal. His presence had a most deleterious effect on the situation. We had heard of him as being the chief obstructionist. Very soon after our arrival news came through that Duffadar Moh'd Shah, who was in charge of our advance transport, had been held up by this chief at Obal, had been fired on, and some of his camels looted. As all idea of proceeding on our journey by this time had been given up we recalled the Duffadar to Bajil with what remained of our transport.

The Arabs, no doubt primed by the Turkish Vali, Mahmud Nadim Bey, of whom more later, first of all presented our Mandub with the *casus belli* in these terms: What had we to say of the blockade and what of the bombardment of innocents at Hodeida and Loheya; who asked us to come into their country anyway; why had we not freed the Turks who were their blood brothers? We were the enemy of all believers in Islam; and for all these reasons we must consider ourselves prisoners, and to prove it they would be much obliged if we would hand over our arms and supplies.

Having got these preliminaries off their chests and made it clear what their future attitude towards us was going to be, they promptly set about putting it into effect. We began to experience an increasing hostility and it was not long before we realized that our lives were in considerable jeopardy. Amongst our supplies was a treasure of roughly £2,000. The amount had grown in the greedy eyes of the Sheikhs to the exaggerated sum of £60,000. It was this hoard that kept the Sheikhs hanging about like flies, each jealous lest one should steal a march on the other.

The Imâm at this same time began to show bellicose leanings; he was deeply offended with the slur on his good name our having been stopped from coming to see him had caused and he was collecting an army to march on Bajil to free us from bondage. An excellent idea but one likely to precipitate our demise. We managed to get Abu Hade, the head Sheikh, to come and see us. He suggested we should give him 200 dollars and 100 for the Holy man, and that then it should not be very difficult for him to see us bag and baggage to Hodeida. I notice in my diary that we had made up our minds to hang on to our arms, those of the sowars and our revolvers in particular, and temporize for all we are worth. I also

see a note: "We are extremely cheery and take our possible massacre philosophically. Being well advised in Arab methods we are hiding our revolvers. They may afford a quicker and less painful way of passing out of this world." When I read this extract I begin to doubt its accuracy. Certainly, as I know myself now, I could not be philosophical about such a horrid prospect.

Boastingly and with much relish the Sheikhs had told us how they had dealt with six Germans, survivors of the "Emden." These brave fellows had escaped from Cocos Island in one of the life-boats and after a perilous journey had landed on the Hadramaut coast of Arabia. They eventually found their way to the Turkish Headquarters at Sana, where they spent a few days recovering from their experience, and then they made for the coast with the object of reaching Stamboul, from whence they hoped to gain Germany. Unfortunately for them their route led through the lands of the Kuhra tribe, our gentle captors, who promptly seized them and as we heard staked them out in a row and performed on each poor wretch a different and more frightful atrocity in full view of the others. As far as I remember we were shown the place where the murders took place, and we definitely saw the lifeboat lying bottom up on the wharf at Hodeida, whence it had been brought.

Then I find a more gloomy foreboding with not so much philosophy about it written on the following day, the last day of August, to this effect:—

"Before we were properly dressed the Sheikhs ascended upon us and without any preliminaries got to business. They demanded speedy surrender of our arms and all our supplies and private belongings. They are at present ransacking the latter. Luckily we had already burned certain incriminating documents. I am trying to keep my revolver hidden with the few rounds of ammunition I possess. We all know that our lives hang on very slender threads, made more slender by the news that has just arrived that Hodeida has been attacked by Arab tribesmen, resulting in an absolute route of the garrison. The Rajputs are reported to have taken to their boats, the Consul captured and being brought here. All lies I expect, but whether true or not rumours of this sort have their repercussions.

4 p.m.: "All the afternoon the Sheikhs have been 'confabbing' in the Holy man's house. They do not appear to be in the best of tempers by the shouting that is going on. It has been frightfully hot all day."

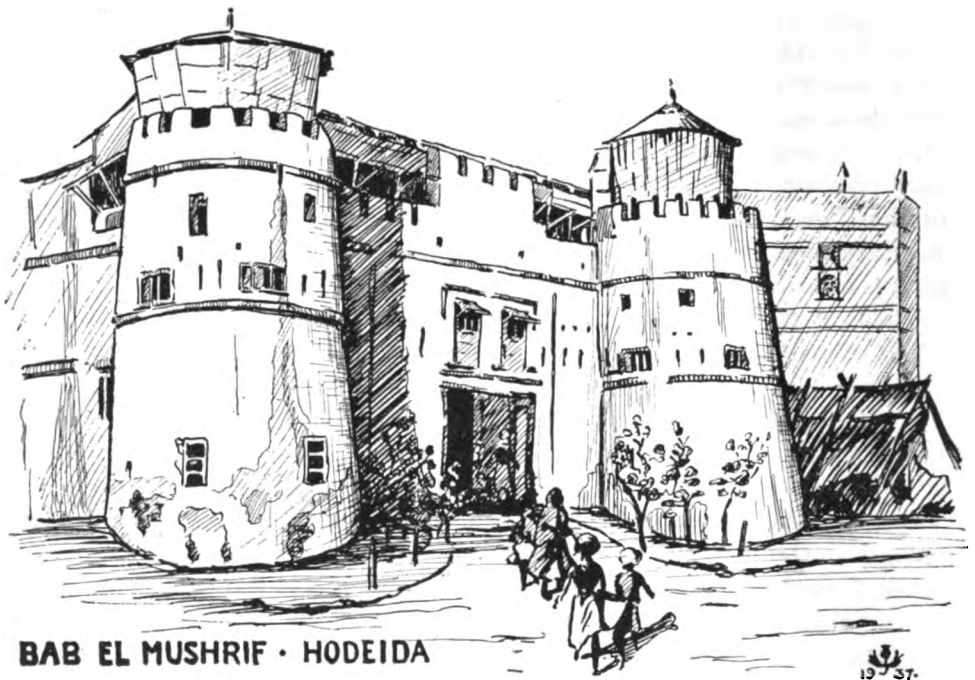
9.45 p.m.: "Our servants have just come to tell us with tears in their eyes that we are to be murdered to-night. One of Moh'd Zaid's men let the cat out of the bag. In consequence I thought it better to write my will, a thing I had omitted to do up to this occasion. I wrote General B. a somewhat private and confidential letter. The Risaldar-



Major came up and he has arranged to rush to our aid should we be attacked. Then Abu Hade appeared and he assured us that we were safe for the night and to prove it he offered to sleep on the roof with us. He stated that the rumour from Hodeida had been confirmed, 150 sepoy had been killed. All revolvers loaded to-night and ready.”

September 1: “ We are still in the land of the living.” And now for the true story as it later became known to us.

It was the Rabasa and Manifera tribesmen, a sub-sect of the Abus, that carried out the raid on Hodeida. At 5 a.m. 150 buddhoos from Beit al Harisa and Marawah, headed by Sheikh Saiyid Ali Bari of the latter place,



The Bab el Mushrif where a picquet of “ the Rajputs ” was surprised.

gained access by the south picquet and slaughtered all the occupants, Arab gendarmerie. The tribesmen passed through the Bab el Mushrif, where they surprised a Rajput picquet killing most of the sepoy. They then divided into three parties, one lot of fifty made for the Consul’s house and ransacked the whole place in search of the remainder of our phantom treasure which report had it was in safe keeping with the Consul who lived in the bank. This gentleman, as you will no doubt have gleaned, was not a great favourite with the Arabs and this was an added incentive to the attack on his property. But when it came to the point “ Faloos ” became the more

attractive proposition and so intent were they in their search that the Consul, aided by a trusted servant, managed to make his escape by a window and scramble to earth and by means of a ladder over a wall. He found sanctuary next door in the house of an Arab who, when later interrogated by the disappointed plunderers, swore on the Koran that he had no knowledge of the fugitive. Another posse of Arabs with intent to loot the supply dump unfortunately lost their bearings and hit the Field Ambulance by mistake. Eight dhoolie bearers were murdered with their own kukris and two hospital assistants wounded. We heard that one little Ghurka Kahas was found lying dead at a window with a bullet through his brain and a sepoy's rifle to his shoulder, while at his side was a heap of empties. He must have had a somewhat longer run for his money than the others who were more or less murdered in their sleep. Two officers of the Indian Medical Service who were sleeping on the flat roof of the hospital were unobserved and came out unhurt. Having realized their mistake the Arabs now made certain of the whereabouts of the supply dump, but the military forestalled them and drove them off. The second party looted two of the biggest shops in the city belonging to Greeks and removed goods to the value of £2,000. The pack camels were loaded up with the spoil and the Arabs took their leave about 8.30 a.m., their departure being hastened by machine gun fire.

Our total casualties were :—

Killed—					
Indian other ranks	..	..	..	..	18
Police Havildar	..	..	..	..	1
Wounded—					
Arab police	..	..	..	..	2

Four ships arrived in Hodeida shortly after noon, the "Espiegle," the "Topaz," the "Kishna" and Cowasjee Dinshaw's "Africa."

They brought reinforcements—250 Brahmin Light Infantry with four Lewis guns; three machine gun sections of the Malay State Guides, and two 10-pounder guns with thirty-five British ranks and two officers.

Having been so successful in the first raid it was not long before the tribes wished to try their luck again. The Kuhra tribe was invited to join but after considerable discussion agreed not to do so. We learned through the Aden Troop the date of the intended attack and the actual picquets which were to be stormed. News to this effect was scribbled on a scrap of paper and smuggled secretly by an Arab who was willing to take the risk because he particularly wished to be allowed into Hodeida.

Sheikh Baghawi, whose fingers were always itching to pilfer, must have had a stiff struggle to exclude himself from the second enterprise. The fact that his territory was nearest to the British Force at Hodeida from whence reprisals would sooner or later be taken against the offending Sheikhs must have very considerably influenced his decision not to

become involved. He, however, did not admit to us what his intentions were and led us to believe that willy nilly he would have to take action through pressure brought to bear on him by his tribesmen. Apparently several of his camel-men were captured in the attack on Hodeida and though without arms (a most extraordinary omission on their part, as every buddhoo carries some sort of weapon) were executed by the military. The news spread widely, Baghawi's tribesmen became extremely wrathful and cried out for vengeance.

Neda, the Indian Political Officer, visited the Holy man about this time and learned that it was with the greatest difficulty the Sheikhs were restrained from commencing a general massacre of the Mission. We were to them a blot on the landscape and needed wiping off. When the first rumours of the victory of Hodeida reached them, their impulse, and we must confess it was quite a natural one, was to complete the successful removal of the British invader at Hodeida by mopping up this small fragment in Bajil so admirably placed at their disposal. It may have been the Holy man, but I rather think it was our ally Abu Hade, who held their hands. He is reported to have argued this wise: "Be not precipitate in your methods. The fish you have netted will not lose their flavour by a little extra keeping. Rumours are at times curiously inaccurate. It would be well to wait till the morrow and have confirmation. Should the glorious news be true, we will not hesitate to strike down our prisoners, then every one of us will have won a way to the Seventh Heaven by our having a death of an infidel to our credit. Allah be praised."

Thus he temporized and thus undoubtedly our lives were saved. His assurance that we would be secure from harm during that night and his offer to prove it by staying with us is therefore explained.

The second attack on Hodeida took place two days after the first. 300 Arabs attacked the North-east picquet with 200 in reserve on a sand ridge behind, while fifty attempted to rush the police picquet on the south. The plan turned out to be exactly as we had expected, both as regards place and date, and the garrison making full use of the tip, concentrated a nest of machine guns at the spot, and in less than an hour drove off the buddhoos with the loss of forty to sixty dead and many more wounded.

This was the best news we could have received, and it had at once the most salutary effect.

On our Mandub's representations the blockade was raised. Famine and starvation were everywhere rampant. The sandy desert, always unproductive of crops at this time of the season, was completely barren. The effect of the blockade was most evident. In Bajil it was pitiable to behold the emaciated children and old people, and the dogs mere bags of bones, ever in search of food. The sanitary arrangements in our quarters

had become so offensive that we were driven to visit a nullah outside the boundary of the settlement which was used by the villagers. A solitary tree (named after a well-known English actor) marked our particular reach. The village dogs used to gather round and sit sentinel over us during the period of our visit. For them it was a case of needs must.



Literally hundreds gathered under our house to receive the grain.

We used to give the local poor an occasional sack of grain, and literally hundreds gathered under our house to receive it. It was the most brutal sight to see how they fought, a mass ten feet high of heaving, struggling and screaming humanity, the strong taking the weak's portion and never content until they had got all that they could. I can see still an aged blind and crippled woman being thrown about in the scrum yelling at the top of her cracked voice. Then when the main mob had dispersed those feeble wrecks scraped with their fingers in the dust for the odd grain that might have fallen there. The cessation of the blockade therefore was welcomed by all.

The sowars of the Aden Troop were compelled to give up their arms and ammunition. No soldier the world over can part with his rifle without a feeling of shame, and this applies especially to the Indian sepoy. His rifle is his sword of honour, he is taught that he must only part with it with his life. The Aden Troop had fought gallantly through the War and held Turk and Arab in contempt, and it was painful to see the humiliation and disgust of these gallant fellows when they were asked to part with the weapons they had carried so proudly. Every man from the Risaldar Major down asked only that they should be given the chance to fight their way out, but our Mandub's policy was no force.

He was always explaining to the Sheikhs that if he had come to conquer their country he would have brought an army with him. He had come with a few to show his honest and peaceful intentions. To us he said "we have far greater chances of getting free by patience and forbearance than by showing fight. It may take a long time, but I promise that I shall see you all safely to Aden." The removal of our arms was not such a disgrace as it might have been. They were collected under our own supervision and deposited in a room on the ground floor, the key of which Sheikh Abu Hade kept. It was a gentleman's agreement that on the first sign of danger we should be given back the key, and I truly think that this Sheikh would have stuck to the pact. Moreover, even without the key I have no doubt we could have burst our way in.

Our mules and camels remained untouched in spite of repeated threats by the Sheikhs to have them divided amongst them. I rather think jealousy was one reason why this was never carried into effect and also the fact that so long as we held them we would feed them, and as fodder was hard to come by and its provision a source of income to the local Arabs, this arrangement would be the best and most economical.

From now on commenced plot and counterplot, intrigue and counter intrigue, endless conferences, confabs and pow-wows, that ended in the same blind alley—impossible ransoms and unacceptable demands.

The whole period of our incarceration can be divided into three phases. First, that during which our Mandub dealt direct with the Kuhra Sheikhs, second when the Turkish Vali Moh'd Nadim became the chief personality in the opposite camp, and thirdly when a political officer arrived in Hodeida and officially relieved our Mandub of all power to negotiate.

It was only in the last phase that practical propositions were discussed and the airy and grandiose aspirations of phases one and two were finally and definitely squashed.

In the very early stages the general consensus of opinion was to destroy us; this splendid idea was rendered even more popular to our captors by the success of the first attack on Hodeida. The second attack which

terminated in an Arab rout, had the effect of damping their homicidal ardour and of bringing to light the fact that we had a money value, and that bartering us for a ransom was more in keeping with the altered situation. The arrival of reinforcements and the rumours of an advance of a British mobile force added still further to the need for a change of policy. Sometimes the Sheikhs would appear in a body and at other times singly or in pairs. Our most constant visitor was Abu Hade, the local Sheikh and our ally, the next in frequency of coming was Baghawi. On many occasions these two would appear stealthily at any hour, day



Ali Salami in deep conclave with our Mandub.

or night and enter into deep conclave with our Mandub and Neda. A visit late in the evening when the Sheikhs were partly drunk on kat was generally productive of some splendid exhibitions of temper. Our Mandub used to face these outbursts with extreme calmness, seated in his camp chair with cheroot in mouth and legs crossed and one finger wagging to emphasize his point. Gambias were at times drawn in anger, but the impending attack was always frustrated by the calmer members. On one occasion Yahea Ali, who was always on the verge of bursting into a blind fury, said he had been insulted by our Mandub because the latter in sitting opposite him had exposed the sole of his shoe; a sure indication of studied insult. He drew forth his dagger from the folds of his lungi and shouting every imprecation he could bring to mind—and his vocabulary of terse and apt expletives was unlimited—launched himself to the attack. I can still see the old villain struggling in the arms of his brother Sheikhs

speechless with anger while the object of his quest sat as usual unperturbed within a couple of feet of his reach. We others were never far off when voices began to rise, and kept ourselves in readiness to rush to our leader's assistance if the need should arise. We had a plan which if carried into effect at the proper moment and with due solemnity, we knew would have the most devastating effect on these primitive men. Ginger B. had a glass eye; Pop like many of us possessed a complete set of upper dentures, but he also possessed the faculty of being able to dislocate them from their setting with his tongue and thrusting them forth from his mouth till they stood completely free beyond the confines of the buccal cavity. The plan consisted of the sudden appearance of these gentlemen in the arena in full view of the warring parties; a halt and then a *tableaux vivante* of presumably one person plucking an eye from out its socket and holding it between the first and second digits in a definitely menacing attitude, and another and smaller person protruding what appeared to be his whole upper jaw, including the teeth, in a provoking and wholly terrifying manner. These buddhoos knew of no artificial aids to appearance and would only assign the phenomenon to one of devilish origin. I do not remember whether or not the plan was ever carried out in practice. I have no documentary confirmation one way or another.

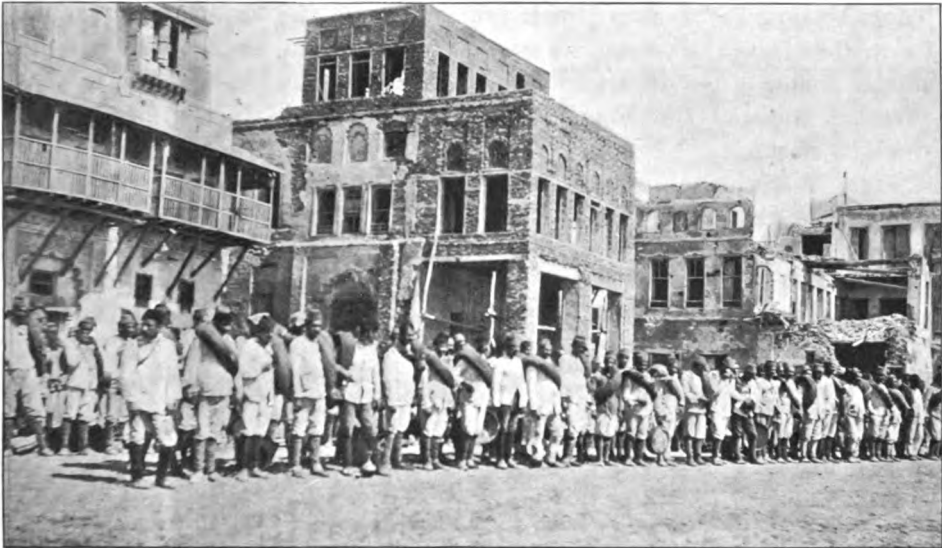
Aeroplanes had never been over these wild parts and the Sheikhs had no idea what they looked like. We were twice raided at night as a result of this complete ignorance, once when Baghawi saw for the first time our five camp beds fitted with mosquito nets all lined up as he thought ready to take off on a flight to Hodeida, and again when, after our lowering a charpoy from the roof to the street below by means of mule halter-ropes joined together, Moh'd Zaid ordered the removal of the latter as he thought we would cast the rope to a passing plane and all five of us swarm up like monkeys and escape unransomed. One of the chief objects of their search, other than for the mythical £60,000 treasure, was for wings such as Mercury wore, which they thought clipped to our heels like jack spurs and by means of which we would take wing like a covey of partridges.

During the first phase, although the negotiations were directly between the Sheikhs and ourselves, nevertheless one could see the Turkish hand in the picture. The Holy Man acted as the chief counsel for the prosecution; he was, I am afraid, less godly than his name would infer. These were the conditions of our release during the early part of Phase I:—

- (1) Opening of the blockade.
- (2) Free circulation of our £60,000 treasure.
- (3) Handing over of mules and rifles.

- (4) British protection from Imamic aggression.
- (5) British protection of trade routes.
- (6) Stipends to all Tehama Sheikhs.
- (7) Heavy ransom.
- (8) Evacuation of Hodeida.
- (9) A Governor to be appointed to Hodeida.

Later during Phase I a long document was presented to the Mandub by Baghawi, the gist of which was: There were definite discrepancies in our Mandub's answer to their preliminary queries. In one place he had said that the military occupation of Hodeida was carried out to facilitate the surrender of the Turks and was only of temporary expediency, then



Turkish troops at Hodeida after surrendering to the British.

he continued by affirming that after the Turks had been evacuated it was necessary to remain on to help the Arabs in their troubles. In another place he admits the Yemen still belongs to the Turks, and will until the Peace Conference decides. They naturally thought that the British Government had ulterior motives and that the military occupation was the thin end of the wedge to annexation. They also were convinced that it was our intention to hand their country over to the Imâm and they admitted they seized us as a precautionary measure.

On September 19 we were awakened by a loud burst of rifle fire. This turned out to be the arrival of Moh'd Nadim, the ex-Vali (Civil Governor) of the Yemen and, since the withdrawal of the Turkish garrison, chief adviser to the Imâm, from whose capital he had sallied forth down the steep gradients of the Zeidi Mountains to Bajil with the object of seeing



to our immediate release. He was a pompous little man with a pink complexion, sagging pouches under his eyes, a small moustache and a fringe of hair round the border of his chin and the smallest hands and feet of any man I have ever seen. He was accompanied by his Turkish A.D.C. in military uniform and fifty Zeidi soldiers. Three of the gang, Abu Hade, Bashawi and Yahea Ali, had gone to meet him with a following of a hundred or more tribesmen and all this noise and bother was to announce to the village their arrival.

With his advent the second or Turkish phase began. Nadim Bey, the Vali, interviewed our Mandub. The Imâm, he averred, was certainly strong enough to descend on the plains and capture the Tehama seaboard and had made up his mind to do it some day, despite all dissuasion. There was, however, no complete unity amongst the Zeidis. The Imâm, he further stated, was a mean and avaricious man, and by this had lost the friendship of certain tribes who during the Turkish occupation received subsidies to keep them quiet, but who, now that the Turks had left, received nothing.

The Imâm had no love for the Turk. There were still Turkish officers in Sana who were not allowed to leave. They got no pay and were to all intents and purposes slaves of the Arabs. Their wives were forced to work in the fields or beg to obtain the wherewithal to live.

Disaster had come to those parts as a result of the complete removal of the Turkish troops and *ipso facto* of any sort of government.

He assured the Mandub that all Arabs wished the Turks back and therefore forecast that the following would be the main demands when the terms were finally formulated by the Sheikhs.

(1) The late Turkish government must be restored, but if the worst comes to the worst it is the paramount duty of the British to supply a government until such time as the Peace Conference has decided what the future of the Yemen would be.

(2) If there is no government, tribes will get out of hand there will be war, bloody war with endless loss of life, the responsibility for which would lie with the British Government.

(3) The Shafa'i are extremely afraid of the Imâm and their security, previously ensured by the Turks, having been removed, they want it replaced as soon as possible. Towards this end a force, either Turkish or British, should garrison Hodeida with an ambassador at Taiz.

He added that if the British Government wish him to represent them in Hodeida, then it would have to provide him with soldiers with which to hold it.

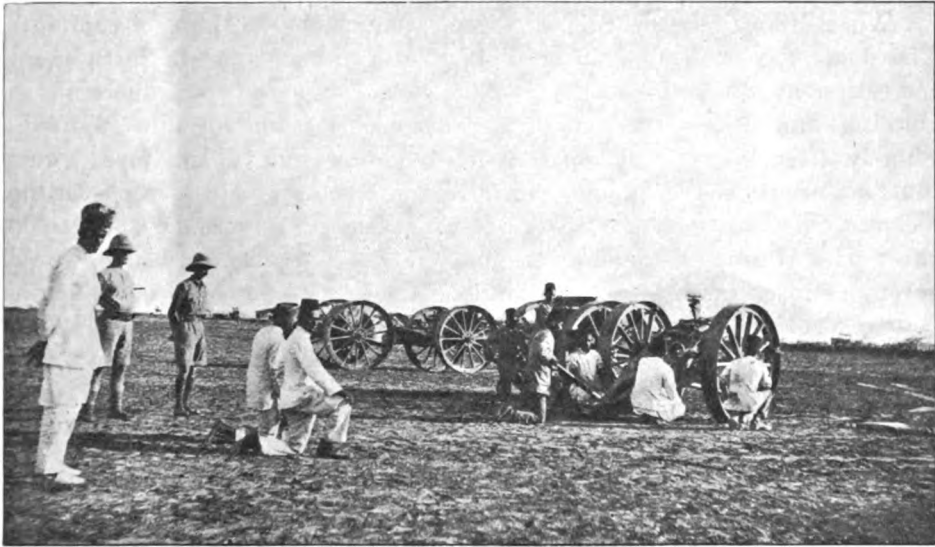
The Idrisi (a tribe north of Hodeida who were nominally pro-British during the War, were given guns and trained to use them by our gunners and who had all their guns captured in the first engagements with the Turks) were on no account to be invited to take over Hodeida.

He was handicapped in his efforts to get us free, owing to the want of money—with a matter of, say, £5,000, he could do a tremendous amount. If we refused the Sheikh's terms we must prepare for an indefinite period of captivity. The Peace Conference will decide, but it should be remembered that the Arabs want neither French nor Italians, it must be Turkish or British rule in the future.

Prior to this interview we had been presented with a long document by the Sheikhs of the Zeranik tribe, neighbours of the Abus, who had attacked Hodeida.

The local chiefs had agreed to its contents and were most interested to learn the reaction its reading would have upon us.

This is the story the paper contained, and it is easy to detect the Turkish influence :—



The Idrisi were given guns and trained to shoot them by our gunners.

“ We, the Tehama Sheikhs, are in unity with regard to one thing which you infidels must get firmly imbedded in your heads, and that is we look upon the Turk alone as our ruler and do not want any interference from you. If our hands are forced woe betide you ; we will fight to the last man. You say we have broken faith with you ; we admit this, and that we did it intentionally in retaliation for your breaking yours when you promised the Turkish prisoners would be repatriated at once, whereas you kept them for several months at Kameran and Hodeida. What sympathy did the Consul show to the Arabs at Hodeida ? Did he not declare martial law in that place ? Did this all agree with the Mandub's statement that the Yemen still belonged to the Turks ? It does not impress us in the least that the British govern millions of Moslems ; that

may probably be quite true, but as it apparently takes you all your time to control them in Egypt, India and Mesopotamia, we would not wish to add to your difficulties.

“We demand removal of the Consul from Hodeida, the blockade opened and the town evacuated by your troops.”

This same Zeranik tribe was very hostile to the Turks during the War; in fact, they were one of the few tribes the Turks were unable to subdue. They offered help to the British forces in conquering the Tehama in return for arms, which offer was simultaneously made to the French at Jibuti. The French Consul very courteously forwarded his letter to the British authorities at Aden. In addition, this tribe blew up the Turkish arsenal at Marawah and captured an important Turkish mail which they offered to sell to the British. The British Government subsidised them and gave them concessions with regard to dhows.

We still awaited the Sheikhs terms, which were “lang o’ coming.” The delay gave the Vali another opportunity to continue to intrigue—a recreation at which he was a past master, completely overwhelming in cunning and deceit the straightforward declarations of the Mandub. Shortly after his first outburst he tried a new line: “Whatever I do I must not arouse the suspicions of the Imâm. I cannot join openly with the Tehama Sheikhs to form a Shafa’i block, though dearly would I love to do this; His Highness would only put one construction on it and would revenge himself on my wife and family. The most practical proposition, of course, would be the return of 4,000 Turks. If this could not be effected then things would become somewhat complicated. If I took over the Governorship of Hodeida as the Shafa’i representative the Imâm would certainly come down on me, and the Shafa’i could not hold out even if given rifles, machine guns, artillery and money. Whatever happens, the Imâm is set on possessing Hodeida, and nothing apart from the 4,000 Turks is going to stop him. Before any move is taken I must have my wife and family down.”

About this time news reached us from the Foreign Office, through the O.C., Hodeida, to the effect that:—

- (1) The blockade should be raised (already accomplished).
- (2) Foodstuffs should be sent up country to the people of the Tehama.
- (3) A ransom should be offered.
- (4) Vigorous actions for our release should be taken by the Political Officer at Hodeida.
- (5) The Imâm should be quietly but firmly told that he is held responsible for our safety.
- (6) Hodeida should be evacuated at the earliest possible moment and handed over to whomsoever our Mandub recommended.

During all this time the Imâm Yayah was naturally disappointed at not having us in his power, and was definitely afraid that the Shafa’i would

play us for all they were worth to obtain concessions for themselves and blast his hopes of a little port and a corridor thereto. He gathered an army and ordered it to march to Hajeila. Here it rested, continuing to threaten further advance to teach these buddhoo Tehamers a lesson. This kept our Sheikhs in a constant fidget and constrained our Mandub to write many appeals for the Imâm to desist as it would mean our certain destruction. I do not think our predicament weighed very heavily on the



The little man would take a seat at the corner of our prison.

Imamic mind, yet by promise and persuasion we managed to check him in his purpose. I am certain he distrusted the Vali, and he had every reason to do so. That gentleman was a slippery fish, and in this opinion two at least of the Mission disagreed entirely with our Mandub. The Vali of an evening would take a seat at the corner of our prison, his faithful Ali Salami at one side of him croaking like a doleful crow and the A.D.C. at the other, while behind, at a respectful distance, stood a Zeidi sentinel with bundook slung across his shoulders. Our Mandub would

occasionally join this select party and offer the Vali one of his precious dolmas (cheroots), while in return our Mandub was allowed to share the benefit of the fountain. What a tremendous appeal running water has for people who dwell in this sun-baked land. Here were five men seated round and seriously contemplating a trickle of water, deriving far greater pleasure from it than any visitor to the Niagara Falls. The total amount of water in circulation was actually two gallons. A kerosene tin acted as the reservoir, a thin pipe led from this to the ground four feet below where it turned up vertically to a height of one foot. When in action the tiny spout of water rose perhaps another foot and fell into a basin from which it was collected and passed back into the reservoir, and so the cycle was maintained. Even we poor fish gazed on it with longing from our position on the roof; listened to the tinkle of the water dropping into the can and stood hypnotized by its movements.

As the intrigue continued the Vali seemed to hold more and more to the idea that our Mandub had favoured, if not actually proposed, that he, the Vali, should have mandatory powers over a Shafa'i block. At a meeting of the Sheikhs he received tremendous applause when he stood up and openly declared that he had broken with the Imâm and that in future he was their governor. He wanted them to look to their frontiers. He was willing even to sacrifice his wives; when all was said and done they were only women and others were easily obtainable. Next day to seal his promise he wrote the Imâm to the effect that affairs concerning the Mission had now gone quite beyond the Imâm's concern and had assumed a degree of national importance and that he, Imâm Yayah, might consider himself from now on out of the picture. His warlike preparations were sheer madness, especially as the Turks were returning and would soon settle his hash.

Meanwhile the Imâm had moved down to Hajeilah, seventy miles from Bajil with 500 soldiers and three guns and again fear ran through the hearts of the Sheikhs.

At this stage Egypt joined in the discussions. The authorities there stated there would be no repatriation of Turks. The Idrisi would be invited into Hodeida, which conflicted with our Mandub's policy of letting the Imâm in when we were freed.

The preparations for war by the British force at Hodeida were worrying our captors as much as the preparations by the Imâm. The Shafa'i found themselves between two pincers but still defiant they threatened to remove us separately and individually to Moh'd Zaid's fortresses in the heights of Gebel Dhamar on the first intimation of a British advance towards Bajil.

*(To be continued.)*

## STREPTOCOCCUS VIRIDANS IN URINE.

BY MAJOR G. T. L. ARCHER,  
*Royal Army Medical Corps.*

IN spite of an extensive literature recording the great amount of investigation which has been carried out on the *Viridans* ( $\alpha$ )' group of streptococci it is by no means clear to what extent they are to be considered pathogenic, and to what degree and where they are saprophytic; in other words, where in the human body their presence may be ignored.

Okell and Elliott (1935) have demonstrated the "almost physiological entry" of *Str. viridans* into the blood-stream postulated by Lewis and Grant, both after dental extractions and even without extractions in certain cases with septic mouths, thus casting doubt on the powers of these organisms to cause endocarditis in a previously healthy heart. This work has been confirmed by Fish and Maclean (1936) who show that the original focus in such cases is the gums and not the living tooth pulp as was previously thought to be the case. The latter also quote two fatal cases of malignant endocarditis following tooth extractions in patients with mitral disease.

Rosenow (1914-1928), the originator of the well-known "Elective localization" theory, considered that localized dental infection (with  $\alpha$  streptococci) was responsible for a number of different clinical diseases. His work has gained a certain amount of corroboration, but has also excited much criticism.

Williams (1932) sums up the general situation as follows: "The part played by these  $\alpha$  and  $\gamma$  (non-hæmolytic) types so frequently and, in certain localities, so abundantly present in the normal individual has been much studied, but their relationships, their power to dissociate and cause pathological changes of various sorts are only just beginning to be known."

References to streptococci in the urinary tract do not appear to be extensive.

<sup>1</sup> The symbols  $\alpha$ ,  $\alpha'$  (alpha prime) and  $\beta$  are used in this paper to designate the types of hæmolysis in blood agar produced by streptococci. (Smith and Brown, 1915; Brown, 1919.)

$\alpha$  type.—There is a zone of unhæmolyzed cells and greenish discoloration round colonies, surrounded by a partially hæmolyzed zone. Alternate incubation and refrigeration produces multiple concentric zones of hæmolysis and blood-cells.

$\beta$  type.—Each colony is surrounded by a perfectly clear colourless zone of hæmolysis. There is no change on refrigeration.

$\alpha$  prime ( $\alpha'$ ) type.—This is superficially like  $\beta$  hæmolysis, but there is a narrow zone of non-hæmolyzed corpuscles around the deep colonies visible under the microscope. The zones enlarge during refrigeration, though multiple zones are not produced.

Rosenow includes nephritis and nephrolithiasis among the conditions which he considers primarily due to dental infections.

Williams includes urethritis in a list of chronic conditions in which  $\alpha$  and  $\gamma$  streptococci have been found.

Longcope (1936) records high antistreptolysin titres obtained in certain cases of acute hæmorrhagic nephritis but rejects this as evidence that the condition is caused by hæmolytic streptococci, believing that such titres merely indicate the recent occurrence of an infection with these organisms.

Heckell and others (1936), however, using a special technique, isolated *Str. viridans* from the prostate, urethra or "bladder urine" in fourteen of seventeen cases of urinary tract infections. They conclude that such streptococci are frequently present in genito-urinary tract lesions, that serological studies frequently show them to be primary invaders, though in some instances they may be secondary, and that "their presence in solitary ulcer (of the bladder), so-called sterile pyuria, prostatovesiculitis, and non-specific urethritis is difficult of explanation except to view them in the role of infecting microbes."

Normal controls are not mentioned.

#### PRESENT INVESTIGATION.

The object of this investigation was to discover if the presence of *Str. viridans* in the urine is of any pathological significance.

The technique was as follows:—

*Tests.*—Urine, which was collected with sterile precautions, preferably by catheter, and defibrinated rabbit's or human blood were added to melted agar at 55° C., plates were poured and the cultures incubated at 37° C.

*Controls.*—To ensure that any growth observed was not due to contamination (or infection) in the blood used: A. Two or more plates were poured for each specimen, using varying amounts of urine (indicated either as + + +, + +, and +, or by definite volume, e.g. 5, 2 and 0.5 cubic centimetres), to observe if growth was proportional to the amount of urine in culture. B. Uninoculated plates of the same batch were tested by incubation.

Either A or B or both controls were used in all cases.

#### CULTURES FROM CASES.

The results of urine culture by this method in thirty-four cases are shown in Table I, A, B and C. It will be noted that with one possible exception absolute sterility was never found. This, in view of the severity of the test, is not surprising. The figures in the table represent cases, not the number of specimens—56 specimens were tested, the number from each case varying from 1 to 6.

#### STREPTOCOCCI.

*Str. viridans* was present in pure culture in four cases, or 12 per cent, and with other organisms in ten cases or 30 per cent.

In nine of the cases catheter specimens were examined. Three of these were in addition to "sterile" specimens, while six were the only specimens examined in the cases concerned. Of the former, two were positive for *Str. viridans* and one negative, *Str. viridans* being isolated from "sterile" specimens in all three. The result of the examination of these nine specimens is shown in Table II.

#### DESCRIPTION OF STREPTOCOCCI ISOLATED.

The morphology and cultural reactions of the cocci isolated were examined in several cases. In fifteen instances recorded the chains were very long and often tangled. It was frequently noticed that the cocci were pleomorphic, being elongated and even bacillary in appearance as seen in chains, while in certain instances from some media the chain appearance was lost and the organisms appeared like bacilli. In this respect they resembled the "pleomorphic streptobacillus" described by Stuart-Harris and others (1935). Such pleomorphism is common, however, with *Str. viridans* (Williams, 1952). Chains of moderate length are recorded in four instances. *Inulin* fermentation was studied in 13 strains: It was positive in 7, variable in 2 and negative in 4. In the case of the organisms exhibiting long tangled chains growth in broth was usually clear with a floccular deposit. These two characteristics were probably rather associated with "roughness" and virulence as described for *Str. hæmolyticus* (Hadfield and others, 1934), than indicative of a definite species. *Hæmolysis*: The hæmolytic activity of certain strains was examined in some detail. The organisms from two cases showed  $\alpha'$  hæmolysis (at first considered to be  $\beta$ ) on human blood-agar, but  $\alpha$  hæmolysis on rabbit blood-agar. Culture in blood-broth of one of these strains showed no hæmolysis. This organism was agglutinated by antipneumococcal serum to 8 per cent of the titre of a Group I serum and 40 per cent of the titre of a Group III serum. Culture in human blood-broth of the other strain showed slight hæmolysis in some tubes.

The phenomenon of certain strains reacting differently to blood-cells from different animals is referred to by Williams, who mentions that Cummings (1927) gave the name *Str. pseudo-hæmolyticus* to strains he found that did not hæmolyse rabbit's red cells, and quotes Brown's (1919) description of a strain which gave  $\alpha'$  hæmolysis in horse blood-agar and  $\alpha$  hæmolysis in rabbit blood-agar.

The strain from a third case which appeared to be *Str. viridans* ( $\alpha$  hæmolysis) in plates produced hæmolysis in human blood broth, while a fourth organism produced apparently true  $\beta$  hæmolysis in human blood agar and  $\alpha$  hæmolysis in rabbit blood agar; culture in human and rabbit blood broth of this strain showed slight hæmolysis in 4 of 8 tubes of human blood but none in rabbit blood. In no case, however, were hæmolytic tests carried out with washed cells or using culture filtrates.



## BIOCHEMICAL REACTIONS.

*The Sugar Reactions were Inconstant.*—Lactose was fermented by all but 2 of 12 strains tested. Glucose was fermented by all of 11 strains tested. Saccharose was fermented by 8 of 11 strains tested, 1 of the others being variable with 2 negative. Fermentation of dulcite was only tested 3 times, all strains being negative.

Mannite, used 8 times, gave 6 negative results and 2 variable.

The reactions with inulin have already been described.

Thus the majority of strains examined appear to fall within Brown's subgroups 3 and 4 of either *Str. mitis* or *Str. salivarius* (Andrews and Gordon).

Salicin fermentation to differentiate between these two groups was not investigated.

TABLE I.

Group A = Cases with signs or symptoms referable (or possibly referable, e.g. backache) to the urinary tract.  
 „ B = Cases with signs or symptoms not referable to the urinary tract.  
 „ C = Cases which could not be classified as Group A or Group B owing to lack of data.  
 „ D = Healthy controls.  
 „ E = Cases in whom the urethra was presumably clean. (Specimens collected being first urine after irrigation in cases of gonorrhœa at the end of treatment.)

Group	No. of cases	No. showing <i>Str. viridans</i> in pure culture	No. showing <i>Str. viridans</i> + other organisms	No. showing <i>Str. fecalis</i>	No. showing other organisms without streptococci	Sterile
A	14	3	5 (1) (2)	2	3	? 1
B	8	1	2	0	5	0
C	12	0	3	1	8	0
D	4	1	2	0	1	0
E	5	0	0	3	1	1

Notes.—(1) In one case from only one specimen of six examined, but four were obscured by a growth of proteus.  
 (2) In one case *Str. viridans* was twice present in large numbers in "sterile" specimens but a ureteric catheter specimen produced no growth.

TABLE II.—RESULTS OF EXAMINATION OF A CATHETER SPECIMEN FROM CASES INCLUDED IN TABLE I.

Group	No. of cases	<i>Str. viridans</i> in pure culture	<i>Str. viridans</i> + other organisms	<i>Str. fecalis</i>	Other organisms (no strep.)	Sterile
A	6	1	2 (1)	1	2	0
B	1	0	0	0	1	0
C	2	0	1	1	0	0

(1) In one case "other organisms" were *Str. fecalis*.

## OTHER ORGANISMS.

Other organisms commonly isolated were diphtheroids (9 cases) and staphylococci—often with the diphtheroids, 17 cases.

The predominant organisms isolated from two cases in Group A exhibited the morphological and cultural characteristics of the genus *Hæmophilus*. One species of this genus, *H. canis* was originally isolated from the prepuce of dogs. The organisms I isolated, however, were hæmolytic, while *H. canis* was not.

## CONTROL CULTURES.

In view of the results shown in Table I, A, B and C, it was obviously desirable to make cultures employing the same technique from the urine of normal individuals. This was done in 4 cases. It occurred to me also that with a view to eliminating organisms derived from the anterior urethra—a very probable source in spite of the not infrequent positive culture from catheter specimens—cultures should be taken from cases of gonorrhœa towards the end of a course of irrigation, the specimen collected being the first urine passed after an irrigation. This was done in 5 cases, the results of each group being shown in Table I, D and E. The groups are very small so that the negative result for *Str. viridans* in Group E cannot be accorded much significance, but it is possibly worth remark that cultures from 3 of these 5 cases were positive for *S. jæcalis* as against 5 (3 as shown in Table I and 2 others occurring with *Str. viridans* and not fully investigated) positives from the 38 individuals in the other groups.

It will be noted that so far there is nothing to suggest that *Str. viridans* isolated from urine has origin other than from the urethra. In a case of adenitis of the groin, suspected as originating from a urethral or meatal infection, a smear from the meatus showed epithelial cells, diplococci and short chains. Two cultures from the apparently dry meatus (one made without cleansing and the other after washing the glans with spirit) both produced a growth of very long chain streptococci. *Str. viridans* was not plentiful in any of the catheter specimens examined, and such growth as was observed might occur as the result of contamination of the catheter in passing.

## URINE AND BLOOD CULTURE FOLLOWING DENTAL EXTRACTION.

I thought it of interest, however, to repeat on a small scale the experiment of Okell and Elliott (1935)—who obtained positive blood cultures for *Str. viridans* after dental extractions—examining in addition the urine both before, and at a considerable interval (usually twenty-four hours) after, extraction. The result of such examination in seven cases is shown in Table III. The series is again very small but shows a complete lack of correlation between positive blood and urine culture in these cases.

TABLE III.—DENTAL CASES.

	No.	Urine Culture	
		<i>Str. viridans</i> both before and after extractions	Other organisms both before and after
Cases having positive blood culture for <i>Str. viridans</i> after extractions	4	2	2
Cases having negative blood culture for <i>Str. viridans</i> after extractions	3	2	1

*Note.*—In no case was *Str. viridans* absent or scanty in the urine before extraction and present or notably increased on culture after extractions.

#### EXPERIMENTS WITH RABBITS.

I now attempted to discover if the inoculation of living streptococci in large doses intravenously in the rabbit led to the appearance of these organisms in the urine.

#### TECHNIQUE.

Fifteen animals were used. They were divided into four series, according to the source of the inoculum used. Each animal in the series was inoculated intravenously with the same dose (calculated by opacity in series 2, 3 and 4) of streptococci suspended in saline. It was either anaesthetized or killed at a fixed time after inoculation, the chest and abdomen opened, blood and urine obtained in a sterile syringe by heart and bladder puncture, and cultures made. The results are shown in Table IV.

From the 15 animals used, blood culture was positive in 8, and urine cultures in 2.

Thus it appears that with large doses of streptococci liberated into the blood a streptococcal bacteriuria may occur in the experimental rabbit. Finally, to ascertain if there was any selective concentration of organisms in the kidneys, known proportions of the kidneys of the rabbits in series 3 and 4 were removed with aseptic precautions, ground up in a sterile mortar with sterile sand, suspended in a known volume of sterile saline and cultured in a series of dilutions in saline. In the case of series 3 the spleen was similarly treated as a control, being the organ where one would most expect bacterial concentration to occur. The inoculum, in addition to being counted by opacity, was submitted to a viable count by culture of serial dilutions for comparison with the serial dilution cultures of the organs.

The animals in series 3 showed a rapid diminution of the organisms in the blood and spleen, as the time between inoculation and examination was increased, while the numbers in the kidney remained relatively steady. At first the concentration in the spleen greatly exceeded that in the kidneys,

but later was lower (if no allowance is made for the relative volume of the organs). A point of interest is the remarkable difference in the total and viable counts of the inoculums used. That in series 3 being in the approximate ratio of 1 : 5 would be readily accounted for by chain length,

TABLE IV.—ANIMAL INOCULATION.

Series	No. of animals in series	Blood before inoculation	Inoculum	Intervals between inoculation and examination (one rabbit at each time)	Blood after	Urine positive on culture for streptococci
1	4	All sterile	Mixed emulsion : <i>short strep.</i> — from blood (of Dental Case 3); <i>long strep.</i> — from urine (Case 10)	2, 4, 7 and 24 hours	+ + after 7 hours  + at other intervals	+ (11 of 16 colonies were <i>short chain strep.</i> ) after 24 hours — at other intervals
2	4	Slight contamination in each case	945 million <i>Str. viridans</i> from throat	12, 18, 37 and 61 hours	+ (single colony) after 12 hours  — at other intervals	+ (one small cluster of colonies) after 18 hours — at other intervals
3	4	3 sterile, 1 contaminated	1,750 million <i>Str. viridans</i> from tooth root (Case 6)	5, 12, 24 and 48 hours	+ + + + after 6 hours + + after 12 hours + + after 24 hours — after 48 hours — all intervals	— at each interval
4	3	All contaminated	450 million <i>Str. viridans</i> from throat	24, 72, 120 hours	— all intervals	— all intervals

but that in series 4 being in the ratio of 1 : 200 cannot be so explained, and probably, together with the longer intervals used, accounts for the failure of all cultures from the animals in this series.

## SUMMARY AND CONCLUSIONS.

(1) Culture of the urine in blood-agar was carried out in 14 cases with symptoms suggesting disease of the urinary tract; *Str. viridans* was isolated from 8.

Using the same technique, 6 of a group of 20 cases without definite history of urinary symptoms gave positive cultures for these organisms; of 4 healthy controls 3 yielded a positive result; cultures from 5 convalescent cases of gonorrhœa taken following urethral irrigation were all negative for *Str. viridans*, though *Str. faecalis* was isolated from 3 cases; and 4 of 7 individuals produced positive cultures both before and after dental extractions, there being no relationship between positive blood and urine cultures for *Str. viridans* in this series.

(2) The habitat of these organisms is probably the urethra, though animal experiment suggests that in the event of a massive invasion of the blood-stream (as occurs in similar circumstances with others, and as is postulated for *B. coli* by Evans, 1935), they may be passed in the urine.

(3) Other organisms frequently isolated under similar conditions are *Staphylococcus albus* and diphtheroid bacilli.

(4) It is considered that *Str. viridans* in the urine is without pathological significance.

#### ACKNOWLEDGMENTS.

I wish to express my thanks to Major W. A. Cowden, Army Dental Corps, for his collaboration in the investigation of the dental cases, and to my laboratory assistants, Private J. W. Allen, R.A.M.C., and Corporal R. E. Young, R.A.M.C., who afforded me great help in this work.

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## Ninth International Congress of Military Medicine and Pharmacy held at Bucarest in June, 1937.

### ORGANIZATION AND FUNCTION OF MEDICAL ARRANGEMENTS IN COMBINED NAVAL AND MILITARY OPERATIONS.

BY LIEUTENANT-COLONEL A. I. C. MARTYN,  
*Royal Army Medical Corps.*

#### GENERAL.

The Directors of the Medical Departments of the Admiralty and War Office, having received information from the General Staff on climatic, topographical and other conditions in the proposed zone of operations, will draw up in consultation the medical organization which they consider necessary for the expedition.

They will decide:—

- (a) The number and nature of hospital ships, carriers and small craft required for the evacuation for the sick and wounded.
- (b) Personnel required and necessary stores.
- (c) Responsibility between the Services for the care of sick and wounded at various stages.

#### DUTIES OF SENIOR MEDICAL OFFICERS WITH FORCES.

(a) To receive and consider the instructions regarding the organization as drawn up by the Medical Departments of the Admiralty and War Office.

(b) To receive information regarding the plan of operations and nature of terrain and beaches and other local resources.

(c) To estimate in liaison with the Staff the number and nature of sick and wounded for evacuation, and organize a system of classification and embarkation thereof.

(d) Arrangement of duties of medical personnel necessary, and order of landing, together with reliefs and reserves of personnel to replace casualties.

(e) To allocate responsibility of Services and reciprocity to assure wholehearted and efficient co-operation on the part of the Services, and to arrange means of intercommunication.

(f) To arrange that food and water supplies ashore are available.

(g) To make sanitary recommendations for beaches.

(h) On completion of provisional arrangements, these should be submitted to the General Staff for approval and finally communicated to all concerned to ensure proper distribution of medical personnel and equipment throughout the various vessels of the convoy and their distribution with the advance troops.

## LANDING.

A Senior Military Medical Officer will land with the Beach Master (who is a Senior Naval Officer on shore) and the Naval Medical Liaison Officer and select a site for collecting the wounded prior to embarkation, the site to be determined by its safety from enemy fire and remote from the point of disembarkation of troops.

## EVACUATION.

Evacuation officers should be nominated from each Service for each beach, whose sole duties will be co-ordinating and tallying of all casualties to be evacuated. The Naval Evacuation Officer should compile and have ready in advance a detailed list of ships showing the number of patients which can be accommodated in each and the class of patients for which the ship is intended. He should call upon all ships to render patients' states at frequent intervals. One hospital ship should be anchored as near to the beach as possible to act as sorting ship, and able to render immediate surgical assistance.

## BOATS.

Detachments of medical personnel following the leading troops must be landed under plans approved by the Staff as a factor of safety in meeting first-aid requirements. At least one Naval sick berth rating should be assigned to permanent duty on each boat irrespective of the Army personnel aboard.

## LANDING EQUIPMENT.

The first consignment sent ashore should be restricted to the barest necessities which can be man-handled by personnel landing, and will provide an abundant supply of dressings, morphine, splints, blankets and stretchers, with ingredients for making hot sweet drinks.

An efficient exchange system must operate between ships and shore of blankets, stretchers, splints, etc., otherwise a shortage will soon arise ashore. No transport other than stretchers will be landed until sufficient terrain has been cleared and the position established, when troops move forward and with them their medical units. At this time it may be anticipated that wheeled stretchers, and possibly motor ambulances, may be landed.

As stated above, a number of military medical personnel will be landed immediately after the leading troops. Their duties will be to bring casualties to the respective dressing-stations in the places allotted thereto.

With successful development of the operation and the arrival of the main covering force, the remainder of the advanced medical units become available for duty ashore. This will enable more elaborate dressing stations to be evolved and facilitate further the conveyance of casualties to the boats for evacuation to hospital ships.

Later, when the position on shore is well established, the place and function of these advanced medical units will be taken over by the larger, more stable and elaborate formations, thus releasing the former for duty in their proper sphere—in medical support of front line troops.

SOME GENERAL PRINCIPLES.

(a) As a general rule military necessity demands that no wounded be re-embarked during the initial stages of the landing operation if such course will to an appreciable degree retard the landing of combatants. Consequently, every endeavour must be made to arrange provision of aid posts on the beaches. Casualties will, however, be dealt with as the situation permits; speedy evacuation to hospital ships is to be desired and will be effected when possible, though the situation may be such that retention in a favourable location on shore offers better chances.

(b) Wounded should be segregated from the fighting forces.

(c) As far as possible, boats used for landing troops should not be used for embarkation of wounded.

(d) Consideration should be given to air transport of sick and wounded in the later stages of the operation.

(e) Re-embarkation: In the event of re-embarkation, such wounded as cannot be cleared will be left with medical personnel and supplies under the protection of the Geneva Convention. The position must be clearly indicated.

This article was prepared in conjunction with Surgeon Commander A. W. North, R.N., Medical Department of the Admiralty.

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THE TRANSPORT, CARE AND MEDICAL TREATMENT OF  
GAS CASUALTIES.

BY COLONEL MUNTSCH.

SUMMARY.

The gas casualty evacuation service, that is to say the transport, care and medical treatment of gas casualties, must be organized on the same general principles as those which are applied in the case of other sick and wounded. The rapid evacuation of gas casualties to medical care behind the line is also a matter of the utmost importance. The organization of this evacuation and first-aid must take second place to the needs of the military situation and must conform thereto.

The gas service should be organized within the general framework of the medical service; not only should its personnel be specially trained personnel of the medical service, but it should also come under the higher medical directorate. An estimate of the probable number of gas casualties will assist in arriving at a proper evaluation of the numbers necessary in the gas service. A review of all available statistics based on the experience obtained from chemical warfare in the World War will lead us to expect gas casualties averaging from 20 to 25 per cent in any future war.

This high proportion of losses, together with the special character of gassed cases, which present a pathological picture quite different from that of other casualties, calls for special measures for dealing with gassed cases.



In casualties from gases of the phosgene type, the transport of such cases can, as a rule, only be carried out within the latent period, that is, within the first hour or two after gassing. The necessarily rapid and smooth rearward transportation of these cases can only be assured by an increase in the amount of transport, particularly that of the motor vehicle park.

For yperite and mustard casualties the question of decontamination is the matter which is most pressing. There can be no doubt that the decontamination of soldiers, who are at the same time wounded and in need of wound treatment, will be undertaken by a medical formation because these two treatments must go together.

But it appears questionable and open to argument whether an otherwise healthy and unwounded soldier, who has been sprinkled with yperite, should be directed to a medical formation. It would be quite a reasonable view to take that the decontamination of an otherwise unwounded soldier is not the task of the medical service which is organized only for the care of the sick and wounded. Here also arises the further problem, whether a decontamination unit, be it composed of medical personnel or of other troops, may make use of the protection of the Red Cross of the Geneva Convention. An exchange of opinion regarding this question would seem to be a desirable subject of discussion for the Congress.

Besides an increase in medical equipment and medical stores for the treatment of gas cases a careful study of the organization of the hospital system is necessary for dealing with gas cases. In the World War it was found necessary to establish special gas wards in hospitals, and even whole hospitals for gas cases in some instances.

Finally, it is possible to take the view that the basis of the whole gas service should be established by the training of specialists and assigning these to the Medical Staff at the headquarters of the Army, as the French Army has done by instituting the Z Army Medical Service. These would form the link between the battle line and the home front in connecting and co-ordinating all research in the subject which was being carried out in the country.

As the excellent and copious literature of various countries shows, the special medical handling of gas cases is in general the same and is more or less confined to the treatment of symptoms. Treatment of the cause with specific remedies is, with the exception of the possibility of early decontamination in the case of those affected by mustard gas, up to the present not known anywhere. As yet the methods of treatment may suffice if the transport organization can be so far improved that medical treatment can be instituted a short time after the gassing.

The aim of scientific research should be to obtain an understanding of the mechanism by which the chemical weapon acts and to find the treatment of the cause.

## THE USEFULNESS OF COLORIMETRIC METHODS FOR ANALYSIS IN LABORATORIES.

BY COLONEL DR. SEITARO YAMAGUCHI AND LIEUTENANT-COLONEL SHUSUKE HORIGUCHI.

The Japanese Army are developing colorimetric methods in clinical and other chemical analyses carried out for their hospitals in a manner similar to that being introduced in our own Army by the Pathological Directorate.

The authors claim that with these methods minute traces of substances can be detected and estimated; simple manipulation only is required and there is no need to isolate the substance to be estimated.

A list of substances in blood, urine and water, which can be determined colorimetrically is given, and it is stated that with improved modern scientific instruments the liability of any serious error in the analyses is negligible.

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## THE DENTALLY UNFIT AND MILITARY SERVICE.

Reporting Countries:—

A. Netherlands (Dental Officer: T. POELSTRA).

B. Greece (Dental Officer: N. CARYDIS).

### SUMMARY OF REPORTS.

The Reports are mainly based on the replies received to the following international questionnaire:—

(1) What are the standards of fitness in the different military services for: (a) The totally edentulous? (b) the partially edentulous?

(2) To what extent is the artificial denture compatible with military service?

(3) How can masticating efficiency be determined?

(4) What are the oral and dental conditions which markedly affect physical fitness in the Services?

(5) Is the serving soldier supplied with artificial dentures at public expense in all circumstances, or only when the loss of teeth or denture is due to military service?

The replies from twenty-four countries, many of which were vague or incomplete, revealed there was no common standard of dental fitness and no scientific means of estimating masticating efficiency. As regards the other questions, the local conditions of service in each country, such as length of service, age-groups, size of forces, etc., were responsible for much diversity in the answers.

The Report from the Netherlands describes experiments into the possible accurate determination of masticating efficiency. These investigations suggested it was unscientific to estimate this merely by a count of the number and position of the teeth—other physiological factors played an important part in the process of mastication and varied in each individual.

The Report from Greece describes the dental standards in that country, the scheme of dental treatment for the various categories and the military employment of the dentally unfit while undergoing treatment.

## League of Nations Health Organization.

### TREATMENT OF MALARIA.

#### STUDY OF THE THERAPEUTICS AND PROPHYLAXIS OF MALARIA BY SYNTHETIC DRUGS AS COMPARED WITH QUININE.

##### Fourth General Report of the Malaria Commission.

*Forwarded by the Director of the Health Section with a request for early publication.*

It will be remembered that in 1933 the Malaria Commission of the League of Nations published its third general report entitled: "The Therapeutics of Malaria." This report was based chiefly on the knowledge acquired by a study of experimental malaria.

Two years later the Commission arranged for experiments to be made on the treatment and prophylaxis of malaria with synthetic drugs and with quinine so as to compare their efficacy. These experiments were conducted according to a plan which had been very carefully prepared beforehand and which involved the use of the same drugs, the same doses and the same technique. They covered 12,288 subjects and were carried out in Algeria, Italy, the Federated Malay States, Roumania, and the U.S.S.R., under the direction of Professor Edmund Sergent, Professor Bastianelli, Dr. Neave Kingsbury, Professor Ciuca, and Professor Serguieff respectively.

The Commission has now drawn up the text of its Fourth General Report on the basis of the lessons to be learnt from these experiments, whilst paying due regard at the same time to the scientific papers that have been otherwise published on the question of the treatment of malaria. This report is the work of a drafting committee consisting of Professor Edmund Sergent, Chairman, Dr. Balfour, Professor Pittaluga and Colonel Sinton. It represents the unanimous views of the Commission. It is entitled, "The Treatment of Malaria," and will shortly appear in the *Bulletin* of the Health Organization. The annexes will include an account of the experiments, a bibliographical review and the text of the observations made by the various members of the Malaria Commission.

We have pleasure in giving below the conclusions of the report:

#### I.—ACTION OF QUININE AND OF SYNTHETIC PRODUCTS ON THE DIFFERENT MANIFESTATIONS OF MALARIAL INFECTION.

##### (a) *Quinine.*

(1) Action on the *trophozoites in primary infections*.—A minimum daily dose of 0.50 gramme of quinine hydrochloride sometimes suffices to cause a temporary disappearance of the trophozoites of *P. vivax*; but a mean daily

*dosage* of 1 gramme for five to seven days is often necessary to cause the trophozoites to disappear (on an average on the third day) and not to make their reappearance in the peripheral blood until after a latent period of varying length, in the course of the first relapse. In quartan (*P. malariae*) the same effects are usually obtained. In infections with *P. falciparum* the average effective daily dose should be fixed at about 1·30 grammes to produce analogous results. In some countries it is even necessary to use 2 grammes in order to obtain a rapid effect upon the clinical attack and on the parasites. With the usual dose of 1 gramme the trophozoites generally disappear *one day later*, on the average, than in the case of *P. vivax*; sometimes their resistance continues even longer.

(2) Action on the *gametocytes* of *P. vivax* and *P. malariae*.—Quinine, in the doses indicated, exercises its parasitocidal activities on the young forms of *P. vivax* and *P. malariae* capable of producing gametocytes, and also on fully-developed gametocytes. On the fully-developed gametocytes of *P. falciparum*, quinine has only a very slight action, but it also impedes the formation of the pre-gametocytes of this species. It may thus be regarded as directly schizonticidal and indirectly gametocidal in the case of *P. falciparum*.

(3) On the acute clinical symptoms of primary infection, quinine, in the indicated doses, has a definite action from the third day onwards (second paroxysms of fever) in benign tertian; its action is less reliable or less rapid, according to the strain of *P. falciparum* concerned, on attacks of malignant tertian which often continue until the fifth dose (third or fourth paroxysm.)

(4) On the frequency of relapses in general quinine has a clearly marked effect which is, however, influenced by individual factors and by the strain of parasite. The treatment of primary *P. vivax* or *P. malariae* infections with quinine in the usual doses of 1 gramme daily is followed by relapses in a proportion of individuals which may be as high as 50 per cent.

(5) The action of quinine on splenomegaly, when suitable treatment is applied in each attack, has proved to be of real efficacy in endemic regions, especially among children. It is but transient, however, if the community concerned is subject to a high proportion of relapses or is exposed to frequent re-infections.

(6) Quinine treatment with the usual doses does not affect the patient's general condition adversely and generally has no depressive or toxic effect, if the period of administration is limited to the strictly necessary number of days. In such a case there is no good reason for thinking that this treatment hinders the processes of immunization, but ill effects may occur when treatment is unnecessarily protracted.

#### (b) Atebrin.

(1) Action on the trophozoites.—Atebrin in daily doses of 0·30 gramme (for adults) has a slightly more rapid action on *P. vivax* trophozoites than

quinine in the usual dose of 1 gramme. The trophozoites disappear on an average after the third dose, and in some cases even after the second. This parasitocidal action appears to continue for a longer period, in that the phase of latency of the disease (absence of clinical symptoms) is established more certainly and lasts somewhat longer after the end of treatment with atabrin than with quinine. On the trophozoites of *P. malariae*, the action of atabrin can be said to be of the same nature. On the trophozoites of *P. falciparum*, atabrin is equally in advance of quinine in certain cases; but the differences between the strains of parasite prevent the drawing of uniform conclusions. The trophozoites of *P. falciparum* disappear from the peripheral blood after the fourth dose of atabrin in 90 per cent of cases.

(2) *The action of atabrin on the gametocytes* is of a similar nature to that of quinine; it has no effect, from the point of view of devitalization, on the gametocytes of *P. falciparum*. But the action on gametocytes already present in the blood is perhaps slightly more marked than that of quinine, particularly as regards the gametocytes of *P. vivax* and *P. malariae*.

(3) *The action on the clinical symptoms of an acute attack is very marked both in benign tertian and in malignant tertian.*—In some endemic regions, where there may possibly be special strains of *P. falciparum*, the therapeutic action of atabrin is even more energetic on malignant tertian than on benign tertian. But, in other cases, the contrary seems to be true. This is why some practitioners and malariologists in tropical countries prefer to use quinine during the first days of the acute attack and to continue with atabrin thereafter. In benign tertian the fever nearly always falls after the first three therapeutic doses of atabrin—that is to say, by the second attack. In malignant tertian the fever falls almost invariably by the third attack.

(4) *The action of atabrin on relapses is slightly more effective than that of quinine, especially in the case of benign tertian and of certain strains of malignant tertian.*

(5) *The spleen rate* in communities treated with atabrin seems to decrease somewhat more slowly than in communities treated with quinine, but the effects of the drug continue to be felt for a longer time during the observation period after the end of the treatment, the decrease in the percentage of enlarged spleens continues longer, and the return of the splenic index figures to their former high level occurs a little later.

(6) *The action of atabrin on the general condition of patients* seems to be determined by factors which, after this form of treatment, are still not entirely known—that is to say, by the action of the drug on the organic defences in general and on the processes of immunization. The yellow coloration of the skin produced by atabrin is a disadvantage, especially during prolonged prophylactic treatments.

(c) *Plasmoquine.*

(1) *Action on the trophozoites.*—The action of plasmoquine on the trophozoites of *P. falciparum* is almost nil. It acts to some extent on the trophozoites of *P. vivax*, and especially on those of *P. malariae*. With small non-toxic doses of plasmoquine associated with the usual doses of quinine or atebrin, better results are sometimes obtained on the trophozoites of *P. vivax* and even of *P. falciparum*.

(2) *Plasmoquine acts upon the gametocytes of the three species, but especially on those of P. falciparum*, which are practically unaffected either by quinine or by atebrin. In minimum doses of 0·02 gramme, plasmoquine devitalizes the gametocytes of *P. falciparum*, and at the same time diminishes their numbers.

(3) There is no advantage in using plasmoquine alone for the treatment of the clinical symptoms of an acute attack in any of the forms of malarial infection.

(4) *Plasmoquine has a definite effect upon the frequency of relapses of benign tertian or quartan.* In association with quinine or atebrin, or administered after either of these two drugs, it is to a marked degree effective in preventing relapses in benign tertian (except perhaps in the case of a few particular strains) and quartan, and appears similarly to reduce the frequency of malignant tertian relapses.

(5) We do not possess sufficient data to assess the action of plasmoquine alone, used either therapeutically or prophylactically, upon the state of the spleens in malarial communities, for it is nearly always administered together with other drugs.

(6) The small doses of *plasmoquine* (0·02 gramme for example) that are now being used, seem to have no serious depressing effect on the general state of the patient. That the prolonged use of plasmoquine may exert some influence on the neoformation of hæmoglobin must not be overlooked.

(d) *Quinine-atebrin, Quinine-plasmoquine and Atebrin-plasmoquine Combinations.*

(1) The few experimental observations that have been published give no indication that there is any advantage in combining quinine and atebrin together for purposes of treatment.<sup>1</sup> Further clinical research is required in order to determine the effects of these two drugs, when administered one after the other (usually quinine first and atebrin afterwards) in the treatment of acute attacks of certain kinds of infection, especially *P. falciparum*.

(2) The combined use of quinine with plasmoquine produces less frequent and less intense toxic symptoms than that of atebrin with plasmoquine. The association properly so called (that is to say, the

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<sup>1</sup> Professor Rodhain, in a private communication, states that he has recently obtained beneficial effects by this method.

*simultaneous* use) of quinine and plasmoquine (for example, up to 0.02 gramme or even 0.03 gramme of plasmoquine daily for short treatments) therefore does not involve any particular contra-indications. Certain authors recommend however that, whenever possible, the two drugs be administered consecutively. For the treatment of *adult groups* under observation (soldiers, workers) there is, however, no serious disadvantage to be feared from the simultaneous use of quinine and plasmoquine, which moreover shortens the duration of treatment.

The association of quinine with plasmoquine represents one of the most efficacious methods of treating *benign tertian* and *quartan* malaria. Treatment with average doses (1 to 1.30 grammes) of quinine-*plus*-plasmoquine (even only 0.02 to 0.03 gramme twice a week) greatly reduces (perhaps more than any other method) the number of relapses in benign tertian (except, as already indicated, in the case of certain strains) and in some cases also in *malignant tertian*.

(3) *The simultaneous administration of atebrin and plasmoquine* appears to aggravate the toxicity of each. It is not to be advised, though it is understood to have been used without ill-effects in certain communities of adult men. It should in any case not be adopted without medical supervision. Consecutive treatment with atebrin first and then with plasmoquine in suitable doses (0.30 gramme atebrin daily for five or seven days followed by 0.02 gramme plasmoquine daily for five days) has no appreciable influence either in reducing the proportion of trophozoites in the blood or on the clinical manifestations. Like the quinine-*plus*-plasmoquine treatment, this method has, however, the advantage of decreasing and devitalizing the gametocytes, especially those of *P. falciparum*. Moreover, from the clinical point of view, it diminishes substantially the number of relapses, both in *malignant tertian* and, more especially, in *benign tertian* and *quartan*.

## (II) PRACTICAL SUGGESTIONS FOR TREATMENT AND PROPHYLAXIS

Without presuming to lay down hard and fast rules, and while avoiding any interference with either the personal freedom of the doctor, who has to take the responsibility for the treatment of each case, or the initiative of the malariologists, who have to judge the different circumstances of the local epidemiology in the field, the Commission believes that it is in a position to give certain indications. Accounts should, however, first be taken of the following points, on which reservations have been made in the previous pages with respect, not only to the individual treatment of patients, but generally also to the application of any therapeutic procedure: (1) The varying reactions of the different parasite strains of the same species and of patients to the drugs; (2) the special indications applicable to the parenteral administration of drugs; (3) the drawbacks of the synthetic products (yellow coloration of the skin by atebrin, toxicity of plasmoquine).

*(a) Individual Treatment of Patients.*

It is always desirable that the doctor should be in a position to diagnose malaria and to determine the species of parasite concerned by a *microscopic examination of the blood*.

In ordinary cases of *P. vivax* (benign tertian) infections, it is almost immaterial whether quinine or atebirin is employed for treatment of the attack. Plasmoquine, associated with quinine or atebirin, or administered after these drugs, has no appreciably useful effect on the attacks, but seems to reduce the frequency of subsequent relapses.

The association of plasmoquine with quinine, or its administration after atebirin, is useful in *P. falciparum* infections, on account of its action on gametocytes and relapses.

*(b) Treatment in the Field.*

Atebrin, when used for collective treatment in daily doses of 0.30 gramme (for adults) for five to seven days, acts in the same way as quinine in daily doses of 1 to 1.30 grammes for five to seven days or more. There is no reason save financial considerations why either quinine or atebirin should be preferred. The manner in which collective treatment is conducted will depend upon the intensity of the endemicity, which is itself the resultant of a series of factors: the incidence of malignant tertian infection (*P. falciparum*), the virulence of the strains, the sensitiveness of the strains to the various drugs, the susceptibility of various population groups, etc.

Collective treatment with quinine or atebirin may usefully be accompanied or followed by plasmoquine treatment, in order to diminish the number of gametocytes and the risk of relapses.

The choice of the *basic drug* for collective treatment should be left to the public administrations or malariological organizations which undertake or control such treatment, and will be guided by local and economic considerations as well as by the preferences of the medical profession and of the population. It should, however, be remembered that the choice of drug, as well as dosage and duration of therapeutic administration should, so far as possible, be directed towards the achievement of the real aim of mass treatment. This aim is: (1) to secure the largest number of complete cures in case of malaria (*intensive treatment of patients*); (2) to reduce to a minimum the risk of anopheline infection, either by direct action upon the gametocytes, or by indirect action on the parasites generally, thereby effecting an eventual reduction in the number of carriers of sexual forms (*gametocyte therapy*). It would therefore be wise not to rely on plasmoquine alone for this second purpose. These considerations also apply to the choice of the basic drug and the manner of its administration to the community, either directly associated with, or followed by, plasmoquine.

There are, however, large malarial areas, especially in the Tropics, where such mass treatment is impossible of practical application for



various reasons, often financial. Under such conditions, it is desirable to provide *adequate and easily available treatment for the clinical manifestations* of the disease, so that the morbidity, the mortality and the physical incapacitation of the afflicted individuals are diminished. Such treatment has very often to be placed in the hands of laymen for distribution, and little or no direct medical supervision is possible. In these circumstances the cinchona alkaloids appear to be the more suitable drugs.

(c) *Mass Drug Prophylaxis.*

Mass drug prophylaxis has a two-fold purpose: (1) to protect the population undergoing prophylactic treatment from the clinical manifestations of endemic malaria, in order that its working capacity and comparative standard of health may be safeguarded without injury to its premunization, even in areas in which it is exposed to repeated reinfection; (2) to reduce, in due course, the sources from which the local mosquitoes may be infected.

No prophylactic method, unless supplied to disciplined communities under stringent supervision, is capable as yet of attaining these two objects. Special stress should be laid upon the desirability—and, at the same time, the difficulty—of promoting the immunization process in the population, which depends precisely upon the degree of tolerance to infection and upon repeated reinfection. At the same time one wishes to avoid the risks attendant upon the presence and persistence of such latent infections in the community.

Experience has shown, at all events, that very useful results can be obtained with *daily doses of quinine* (0.40 gramme) administered during the whole of the malaria transmission season, and even for a few weeks longer. This is also true of *bi-weekly doses of atebirin* (0.20 to 0.40 gramme per week) administered in certain conditions. With the latter method (bi-weekly atebirin), which has given encouraging results, further trials would be desirable. The daily dose of 0.05 gramme of atebirin recommended for prophylactic purposes has proved inadequate. The harmlessness of quinine makes it a suitable drug for administration by subordinate personnel without constant medical supervision, whereas such supervision is essential in the case of atebirin.

Plasmoquine should not be distributed for prophylactic treatment otherwise than under direct medical control. Its use in mass prophylaxis would be justifiable only if it were administered to a disciplined population, which should be kept under constant medical care. It is useful more especially for the purpose of ultimately reducing the number of gametocyte carriers and arresting the transmission of infection to the anopheles. Plasmoquine is certainly the gametocidal agent *par excellence*, especially where *P. falciparum* is concerned. But both quinine and atebirin also exercise in the latter case a gametocidal action (mainly indirect) by destroying the sexual forms in process of development.

The real efficiency of such methods in the field is, moreover, largely dependent upon a highly important epidemiological factor, namely *the children*. The proportion of gametocyte carriers is much higher among children than among adults, given the same environmental conditions (village, house, family) in respect of endemicity and anophelism. Children, on the other hand, are more difficult to subject to regular treatment, and finally, as already pointed out, the *doses* and *form of administration* of atebirin and plasmoquine to children cannot yet be regarded as finally settled.

(d) *Drug Eradication.*

Experience has so far shown that the eradication of malaria from a locality by the curative and prophylactic treatment, with the drugs at present available, is practically impossible. To begin with, it is impossible to reach, in sufficient time, all the inhabitants of an area, or even of a small village. Moreover, while curative and prophylactic treatment *may greatly diminish the morbidity yet it cannot suppress the parasites in all the carriers*.

In this Report the Commission has not considered the question of expenditure entailed by treatment and prophylaxis campaigns, which depends upon the price of drugs and the cost of staff. It would, however, emphasize the great importance of this problem—which will probably be studied in detail by the Malaria Commission in the near future—in connection with the choice of drugs to be used for curative or prophylactic mass treatment.

Among those drugs quinine still ranks first in current practice, by reason of its clinical effectiveness and almost complete absence of toxicity, coupled with the widespread knowledge of its use and dosage. As regards the synthetic products, which have only been used in therapeutics for ten years, the Commission hopes that it has discharged the duty which devolved upon it by giving in this Fourth General Report an account of the present state of our knowledge regarding the possible use of *atebrin* and *plasmoquine* in the treatment and prophylaxis of malaria. In certain circumstances, as has been shown above, these drugs—representing a notable scientific advance—possess a very special value.

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## Clinical and other Notes.

### ON SOME ASPECTS OF MANIPULATIVE SURGERY.

BY MAJOR I. H. LLOYD-WILLIAMS, M.C., M.B.,

*Royal Army Medical Corps (T.A.).*

MANIPULATION has most probably been practised to a varying extent since ancient times. Progress received a heavy set back from Hilton's theory of rest which was followed slavishly by the profession.

The movement of joints fell into the hands of the unqualified bone-setter. Many of these became quite expert, but lacked knowledge of ancillary subjects, such as pathology.

The Great War produced its holocaust of injuries, and the treatment of numerous stiff joints had to be undertaken. This formed a problem for the solution of which the profession was not prepared. The lesson learnt was that although manipulation was necessary to restore function, there was for each case a proper time to do it.

Experience has shown that considerable wariness must be exercised where there is an infection present. An acute infection is usually best left to quiet itself until the quiescent stage is reached, although it may be noted that some surgeons will treat an acute arthritis by drainage and active movement.

One of the lessons of the War was that too early manipulation in this type of case is very apt to produce a general diffusion of the causal organism. This is particularly likely to occur where the complete restoration of function is attempted at one sitting.

This fact added to the practice of certain well-known bone-setters, who saw the cases after infection had died down, and so got results which should have been obtained in hospital.

There are, of course, other contra-indications, most of which are absolute, such as tuberculosis, growths of bone, and such conditions as osteoporosis and ankylosis, whether from bony union across the joint or from interlocking osteophytes. These are obviously unsuitable.

Diagnosis should be as nearly complete as possible. History plays an important role in directing attention to the pathological condition present. X-rays are very important, and in some cases a bacteriological or serological examination is necessary.

The principal indications for manipulation are, besides the ordinary dislocations as described in surgical textbooks, intra-articular adhesions, peri-articular and synovial thickening whether of traumatic or infective origin, peritendinous fibrosis and fibrositis of muscles or nerve trunks.

## ILLUSTRATIVE CASES.

(1) A middle-aged man of athletic build developed a synovitis of the knee while being attended for an entirely separate condition. The effusion did not respond normally to elastic pressure and he was considering going to a bone-setter. He was persuaded to have an X-ray, which revealed a sarcoma of the lower end of the femur. To ordinary clinical examination there was obvious swelling of the bone; manipulation would not have been successful and there was the risk of a fractured femur.

(2) A footballer developed a synovitis of the knee as a result of a strain. Elastic pressure was applied with limited active movement. The fluid was not absorbed in the usual time of about seven days. The knee was then forcibly flexed, with the result that the fluid was rapidly absorbed. In this type of case there is presumably a coagulum formed which prevents absorption of the fluid. The result of the manipulation is to free the synovial membrane, and the normal contours of the joint return almost at once.

(3) A cyclist was knocked off his cycle by a car and pitched on his shoulder on the kerb. When seen shortly after there was a definite hæmatoma between the deltoid and the head of the humerus. The X-ray was negative. Adhesions developed, producing pain and limitation of movement. With radiant heat, manipulation and exercise, a satisfactory functional result was attained.

When manipulation is to be performed, a knowledge of the normal range of movement is necessary. In each case there should be a comparison with the contralateral joint, as there are ordinarily variations from the average.

There is always the question as to whether full range of movement is to be attained at one operation or by a series. In the former case an anæsthetic, such as gas or evipan, is advisable to abolish pain and also to obtain muscular relaxation.

A series of manipulations is indicated in cases of quiescent infection, for example, rheumatoid arthritis, and in peritendinous adhesions. For the latter condition manipulation will be required in the opposite direction to the pull of the muscle. To attain full movement on the other hand, muscular contraction will attain the desired result; this may be either active or the result of faradic stimulation.

Along with the freeing of the joint movement must be considered the restoration of function to the controlling muscles. Unless these get back to their original efficiency, weakness of the joint or recurring attacks of synovitis are apt to occur. Muscular wasting occurs early in joint lesions, and is perhaps most noticeable in the extensors of the knee. Re-education of the muscles plays an important part in the after-treatment if a satisfactory result is to be attained. This, perhaps, is more noticeable in cases of rheumatoid arthritis.

## AN IMPROVISED MEAT SAFE.

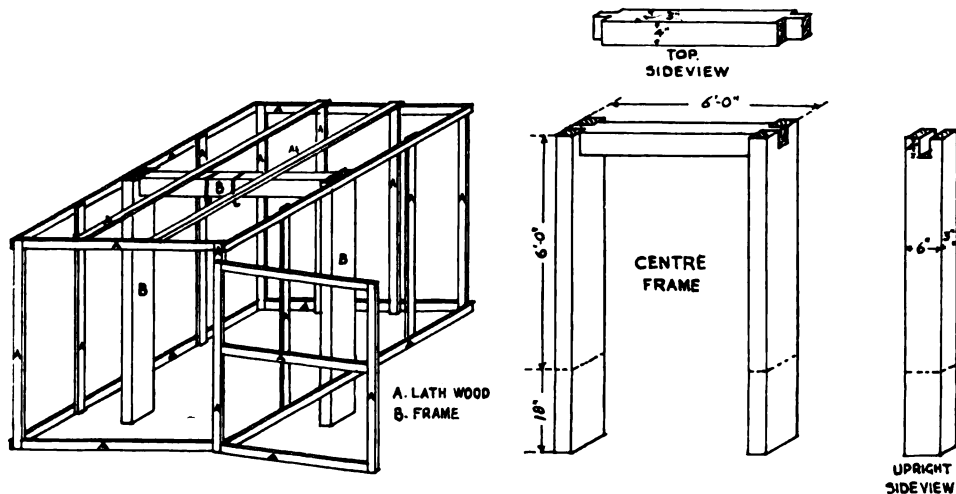
BY LIEUTENANT (QUARTERMASTER) R. MILLNE, M.M.

*4th Battalion Prince of Wales Volunteers (T.A.).*

THIS meat safe was devised by Major W. A. Okes-Voysey, T.D., 4th Battalion the Prince of Wales Volunteers (T.A.), at their Annual Camp, and proved most effective.

It consists of an inner frame strong enough to support the weight of the meat and an outer frame made from the laths used by builders for supporting slates on roofs. The outer frame is covered with muslin, fixed by tacks, with small pieces of cardboard as washers to prevent tearing of the muslin.

The door is also constructed of slate laths and is not hinged, but fits lightly into the aperture.



Door separate, leaning against the frame.

The whole structure is very easily made and most inexpensive to construct. It obviates the far too common method of laying muslin direct on to the food, which is no protection from flies at all.

## MATERIAL REQUIRED.

Centre Frame : 2 uprights 3 inches by 6 inches by 7 feet 6 inches.

1 cross bar 3 inches by 4 inches by 6 feet.

Outer Frame : 1 bundle slate laths  $\frac{7}{8}$  inch by 2 inches by 8 feet  
(about 150 feet).

20 yards muslin about 50 inches wide.

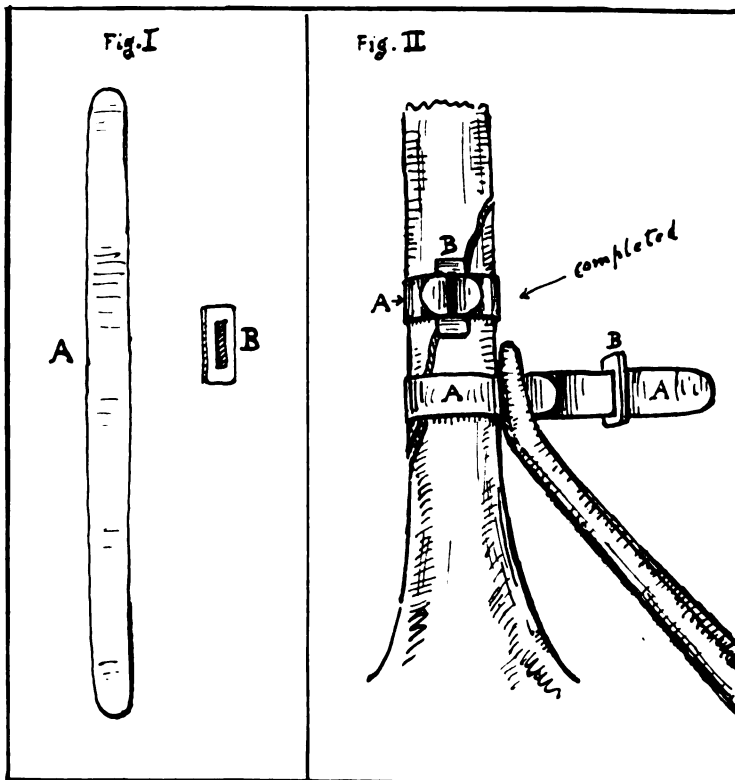
3 iron hooks to fit over cross bar.

# AN IMPROVISED METHOD OF FIXATION FOR SPIRAL AND OBLIQUE FRACTURES.

BY LIEUTENANT-COLONEL W. L. E. FRETZ, M.B., B.S.,  
*Royal Army Medical Corps.*

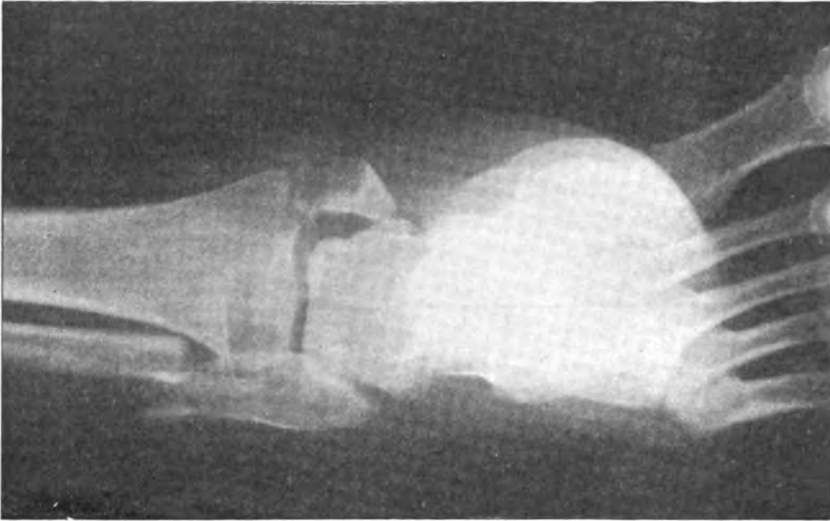
EVEN with the most modern methods of treatment of fractures by skeletal traction, manipulation under fluorescent screens, etc., it sometimes happens that satisfactory reduction, due to various causes (e.g. interposition of muscle), cannot be achieved, and operative intervention has to be resorted to.

While in India, I once was faced with a case of this kind in which a broken leg had united in faulty position, resulting in shortening and

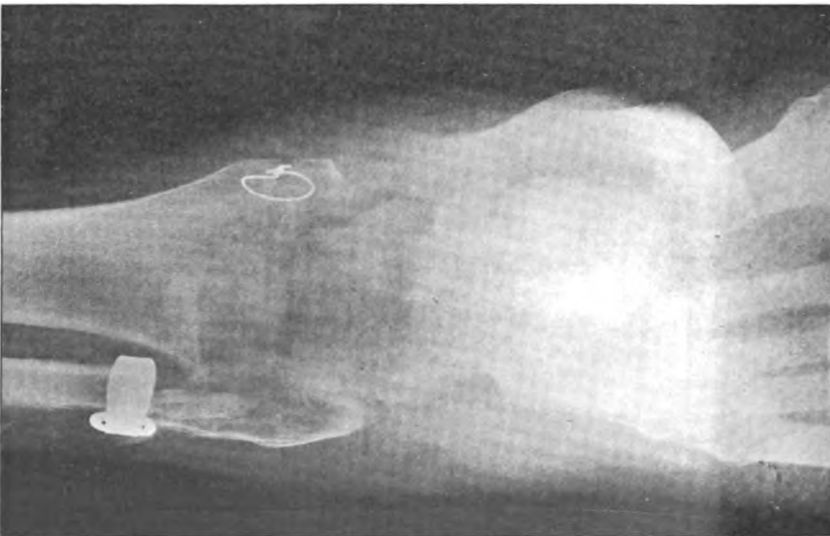


unfitness for service. As I dislike plating a tibia and wiring is worse, and equipment for Parham's bands is not supplied to Military Hospitals in India, I was sitting in my bungalow, trying to think out some method of fixing a band round a fracture which would not result in constriction of periosteum and yet give some reasonable chance of immobilizing the fragments without leading to non-union. Just then, the telephone man

came to fix up my telephone. His method of fixing the wires to the wall was the very thing. A visit to the telephone exchange and I came away with a handful of clips, and another to the Dental Department provided a sheet



CASE 1A.



CASE 1B.

of malleable metal, which was cut into strips of the required length and width.

The leg was operated on—faulty union corrected—fragments banded into position and the patient returned to his unit fit for duty after about four months.

Since then I have used this method in about a dozen cases and in no case have I had reason to be dissatisfied with the result. The bands have always been removed after varying periods when radiograms showed union, and in some cases had to be literally dug out of the firm callus. Recently, I have had to use bands in two cases who have been patients in the Military Hospital, Colchester, and possibly a description of the methods with radiograms of results may be of interest. Fig. 1 shows band and clip, and fig. 2 shows the method of application and the completed result. The sketches are self-explanatory and need little description. The method I use is roughly as follows, though modifications suggest themselves in the course of the operation.

After passing, as a guide, an aneurysm needle or a curved retractor handle round fragments in position, the band is guided round, ends clipped with a bent pair of artery forceps and clip B passed over the ends—one end cut short and turned over, the other end then cut, turned over, and if necessary with a “sardine tin opener” movement of forceps it can be tightened and then also cut short and tapped flat.

The following are descriptions, with radiograms, of three cases in which the method has been used.

*Case 1* was admitted with a fracture of both bones of the ankle, the result of a blow. He was operated on and as shown by the radiogram, the tip of the medial malleolus was wired into position and a comminuted fracture of the fibula corrected by fixation with a band.

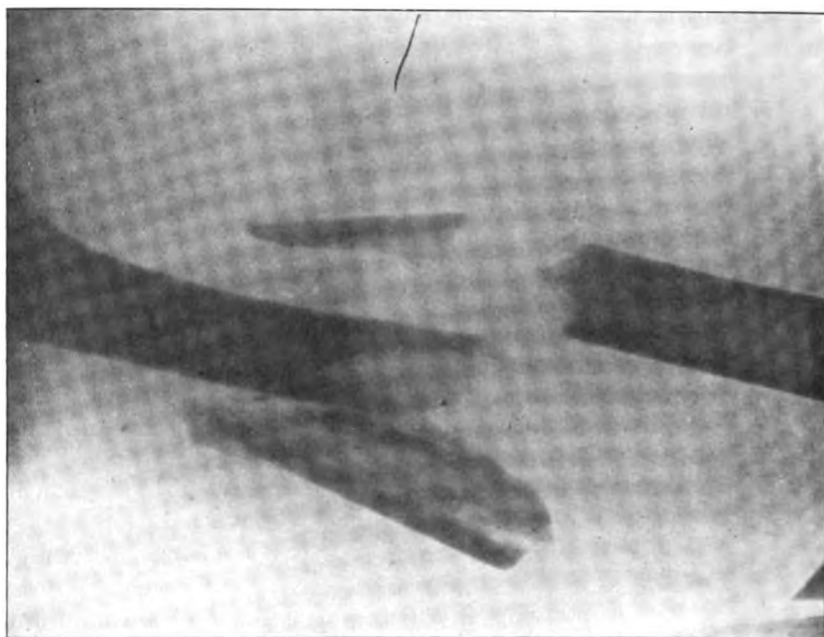
The case is interesting because, on admission, he confided to me that he was afraid that his chief enjoyment in life would be gone, as he felt he never would be able to dance again. However, when I last heard from him, he was at home on leave and back in his night club haunts with his terpsichorean agility in no wise impaired. In this case I made a point of operating on his fibula, as the union in correct alignment of this bone after fracture is, I think, very important and is often neglected. Faulty union with shortening leads to loss of the natural buttress to eversion at the ankle joint, subsequent forward displacement of the astragalus may result and the vicious cycle continues; while union with lengthening leads to non-union of the tibia due to the rigid strut thus formed, as is pointed out by Böhler.

*Case 2* was the result of a motor cycle accident, an occurrence frequently met with in these days of mechanization. As may be seen from the radiogram, some form of operative treatment had to be undertaken. After a fortnight in light extension with a Kirschner's wire through the tibia to enable extravasation and œdema to settle down, the fracture was exposed through an anterior incision.

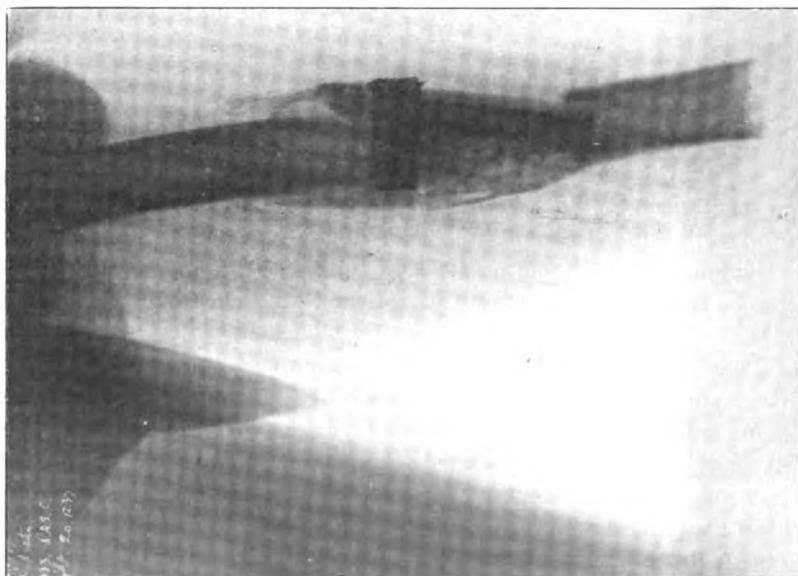
The large loose fragment was found to have been driven almost through the quadriceps and was lying subcutaneously, but still fortunately was attached by a band of periosteum to the proximal portion of the femur.

There was, of course, considerable damage to the muscles around the





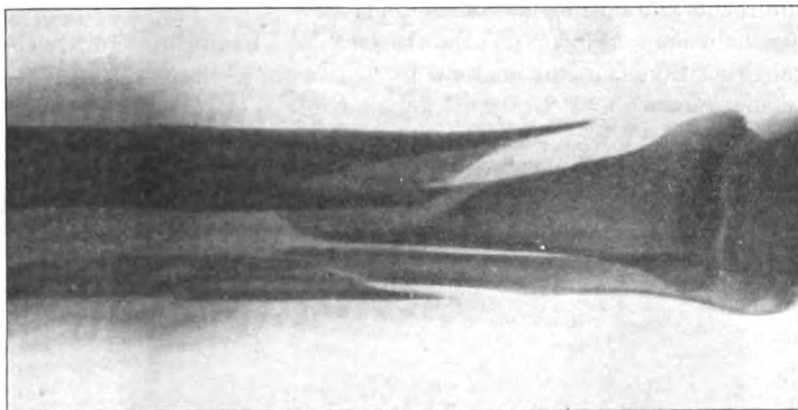
CASE 2A.



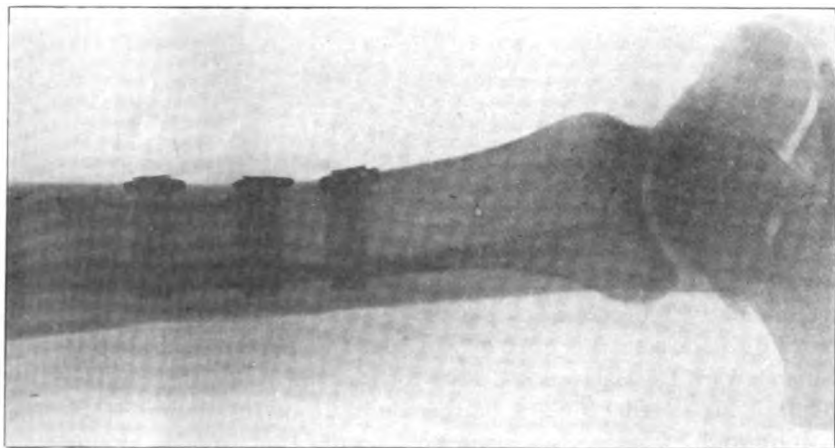
CASE 2B.

jagged edges. The upper end of the loose fragment was re-fitted into the site of its detachment from the femur and fixed with two bands, the lower end was shaped and wedged into the medullary cavity of the distal part of the femur, in the hope that the whole piece would act as a graft.

The radiogram shows the condition ten weeks after operation. Position has not altered since operation and good callus formation is progressing.



CASE 3A.



CASE 3B.

After getting about on crutches in a spica plaster splint for six weeks, this has been replaced with a walking caliper and he has gone home for Christmas.

*Case 3* was the result of a football accident.

Continuous skeletal traction with os calcis pin for fourteen days and repeated attempts to reduce the deformity under X-ray screen had failed, so operation was decided on. The upper end of the lower fragment was found to have pierced through the interosseous ligament, and entanglement in

this and the muscles on the deep surface of back of the leg prevented the reduction.

Structures were freed and the fragments got into position and fixed with bands. The radiograms show the position before and three weeks after operation. The wound has now healed and the patient can lift his leg off the bed without difficulty and move the ankle-joint. He is going out for Christmas with the leg in plaster and a walking iron, and I see no reason why the result should not be satisfactory.

In conclusion, I have to thank Dr. W. Crampton-Gore, Civilian Medical Practitioner at this hospital for his kindness in making the sketches for the diagrams 1 and 2, also Colonel J. M. Weddell, F.R.C.S., K.H.S., Consulting Surgeon to the British Army, for his help and advice in Case 2, to Lieutenant-Colonel O. R. McEwen, M.D., M.R.C.P., R.A.M.C., Officer Commanding Military Hospital, Colchester, for allowing Cases 2 and 3 to be sent for publication, and Mr. S. H. Wilson (late R.A.M.C. and now of Kodak, Ltd.) for the reproductions of the radiograms.

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## Travel.

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### AFRICA, 1934.

BY MAJOR D. GORDON CHEYNE, O.B.E., M.C.

*Royal Army Medical Corps.*

*(Continued from p. 62).*

After a few days' rest it was decided that the time was ripe for making a start on the next safari, and there was great excitement when it was announced that this was to be John's treat and was to consist of a trip up to the famous Murchison Falls where the chances of seeing game of all sorts were exactly 100 per cent.

Accordingly, on the morning of July 14, the party assembled, and this time consisted of Doris Hopkins, Miss Bagot, the Lady Superintendent of the hospital, Mr. Petherwick, a banker on tour of inspection from South Africa, John and myself. Loui was not coming this time as she had done it before, and also she wanted a rest from driving. We were making for Butiabe on Lake Albert, where we would catch a steamer and sail up the lake and then up the Nile to the Falls. Let me repeat again that the White Nile rises at the Ripon Falls tumbling out of Lake Victoria, and then it flows through Uganda over the Murchison Falls into Lake Albert. Then it comes out of Lake Albert and flows through the Nile Province making ultimately for Khartoum, where it joins the Blue Nile which rises in the Tsana Falls in Abyssinia.

The route was via Hoima and Masindi, and we finally pulled up at the

Lake Albert Hotel, which is about twelve miles from Butiabe. This is a very nice hotel and we spent a very pleasant evening and had a most excellent dinner. About eleven we started off and reached the river quite quickly. The small steamer awaited us.

There was quite a comfortable cabin and the ladies were able to rest while the men lay on the decks. There was a crew of about five men. The steamer burned wood, and the sight of sparks flying from the small funnel made an eerie sight, and I suppose was not entirely devoid of risk. We got some sleep, but at the crack of dawn everybody was on the *qui vive*. We appreciated that we were now at the mouth of the river, and we had to be careful that we did not ground on the bar. We transferred from the steamer into a motor boat. All went well and we entered the river. The first interest was a great flock of pelican wheeling round us. This is certainly a country of vastness and thousands of everything. To-day was



The Murchison Falls.

to prove it. The river widened a bit and the banks at first were fringed with tall elephant grass, but not so tall that game was hidden. Everybody got on with glasses to some enormous creature among the grass. I thought it was an elephant with its trunk up. Somebody else thought it was a giraffe. These may have been reflections of last night's party. Anyhow it turned out to be a giant crane. Next we saw Kob, water buck of various sorts, kongoni and impala. It was impossible to photograph these with an ordinary lens as the river was very broad, and one had to be on the alert to see everything which presented itself at either side of the river. This was so trying that Petherwick, who was certainly the father of the party, suggested a little something. Somebody thought it might be a shade early and found it was only 8 a.m. Then somebody sighted an elephant, the first I had ever seen outside a zoo. It was a lone one, but it was one. It was a good distance away. Presently three appeared, and later hundreds.

We saw one big fellow close down to the water's edge in rather thick jungle and we asked the captain to stop his engine and to try and drift

along as near as possible. This he did with enormous success and we got within thirty feet of a beauty and had excellent snaps of him. He threw up his trunk and shot ears forward and stamped his feet in rage, but he could not get out of the thicket and we drifted past him. It was a good sight and worth making the trip to Africa. Amongst the hundreds of elephants we saw that day were elephants of all ages and I should say that the young ones stay with the parents much longer than do other animals. It was delightful to see the way in which the father first shepherded the young ones to cover and then gently shoved the old lady after them and finally when they were all in safety old dad thought only then of himself and up went his trunk with a—"that to you"—and he too was gone. The banks of the river were not particularly hilly but merely had small undulations. However the speed and manner in which these enormous creatures could



The Elephant.

take cover was nothing less than marvellous and they must have known every bit of the area and the value of ground. These elephants were rather lightish in colour a pale brownish, but this was, I think, due to dust and mud and for purposes of camouflage presumably. I spotted one fellow with only one tusk. These elephants, like I believe almost all animals, had their parasite-eating birds something like paddy birds, which of course also give warning of approaching danger. We came to a bank, a nice and sandy one on which the sun was shining, and this was covered thick with enormous crocodiles.

We had to be very quick in photographing them but I was again very successful and the prints enlarged well. One of these photos would have been worth a lot when it was still undecided how a crocodile progressed on dry land. These of mine show quite clearly how he gets right on to his legs, but that has been settled long ago. These brutes were about twenty feet and upwards long and were of a peculiarly light colour, a yellowish hue, and much lighter than the Indian fellow which I had seen in many parts.

The speed with which they got back to the water was amazing. Further up the river they were lying in thousands just like sardines in a tin. Later I saw the place which the makers of the "Trader Horn" film had made to get a big concentration of the brutes. They made a sort of small harbour. Note that at least parts of that film were made in Africa for my sister actually entertained some of the actors and actresses in it. Our next thrill was the hippopotamus. Coming across a marshy bit I counted seventy hippos; I photographed them and with the aid of a lens, seventy can be counted. Coming down the river in the afternoon a school of hippos came all around. My snaps of these are not very good but anybody of average intelligence can tell that they are hippos and you must take my word that the splashes in the water are hippos. I saw one very large hippo right out of the water taking a walk well away from the river. I am told that they



Crocodiles on the bank of the Nile, near Murchison Falls.

frequently hold up play on the golf course at Entebbe. The thought of this possibility may have accounted for the quality of my play there.

After a day of this sort of thing one becomes very quick at spotting unusual movement and I called everybody's attention to a movement away in the distance. Actually this was not very clever as there was a good deal of dust accompanying the movement, but I did spot it first. I thought it was another herd of elephant coming down a ravine to drink. With the aid of glasses we were able to count about fifty buffalo, but we did not get a long view of them. Either by smell or vision they must have spotted us and they were off up the ravine again. This was a great piece of luck for often people do this trip and see none. Indeed we had great luck the whole day for we saw practically everything possible except the elusive lion. One party had the unique experience of seeing a fight between a crocodile and a lion and I think I am right in saying that the crocodile succeeded in downing the lion. The banks of the river were more wooded as we got further up and soon we had our first view of the falls. The river narrows

considerably at this point for it has to be remembered that the river falls into a chasm at the top only fourteen feet across. The volume of water coming over in the cascade can be appreciated by comparing the width of the river at the falls and immediately after. It was a grand and glorious sight and most impressive with the roar of the waters. We drifted in to the side and came ashore. You must realize that all this area is a preserve and that the game has not been shot except by the game rangers to thin it out. We were an entirely unarmed party. We were now about to ascend to the top of the falls on foot at noon on a very hot day in the



Murchison Falls where the river tumbles through a 14-foot gap.

heart of the elephant country of Uganda and also right in the middle of the fly belt and I don't mean house flies but tsetse. (Was I afraid? Yes).

We started off and I felt rather like Livingstone must have felt when he went off into the unknown before he met Stanley. We sent one of the boatmen to lead—just to show the way.

There was a large tree close to where we stepped ashore and I swear I heard something growl but I thought it best to say nothing and even the school boy whistle as he passes a cemetery at night was out of place. Somebody said as we were climbing a hill along a narrow track that in the event of anyone meeting an elephant on the track he must whistle back to the others, and then they must get off the track and let the elephant pass,

hanging on in the meanwhile to any tree below. When I say that any tree off the track on the only side possible was little more than a blade of indifferent grass, and when I say that the same bit of grass was to keep one from falling down the hill side into the river, and when I add that on the banks immediately under lay hundreds of crocodiles with an ever watchful eye on our party, you will better understand that a sharp and constant lookout was kept ahead for the possible elephant and at the same time every blade of grass was looked on as the only thing between safety and a non-conducted tour through the stomach and intestines of a hungry crocodile



At the Murchison Falls, looking towards Lake Alber

with no return. I have attempted to be humorous but in actual fact I have not romanced. Everywhere along the track we followed were signs of the recent passage of elephant in masses, some of their dung was obviously recent. The explanation of our not encountering any on the track almost certainly lies in the fact that we were heard approaching and that the elephants went deliberately off the track and so avoided us. People have failed to get to the top of the track to see the falls as elephant have barred the way and on one occasion for the same reason my sister's party were unable to get any distance away from the boat after landing. Well this time we did get to the top and I did see a tsetse fly. It was very hot indeed, but we were repaid a hundredfold for our labours, worries



and tribulations. My photos on this day are some of the best I have ever taken. I took the falls from all sorts of angles and I consider it would be hard to get a better series than I got that day and modestly may I say that some were taken at some risk for I hung over to get the one of the raging tumbling torrents.

And so we retraced our steps back again without any mishap, all conscious I think of the greatness of Nature and of man's puniness compared with these great things which we had been privileged to witness.

Coming down the river we had some magnificent views of elephant and hippos and all the usual small game, and a good few monkeys of various kinds.

We returned to Kampala the following day.

There was something to do every day, either tennis or golf sometimes at Entebbe, and very often in the morning I accompanied my sister on her shopping expeditions. We took the cook with us and went off to the market. The market is, I gather, a fairly new one and it appeared to be very well run, so it was considered quite *de rigueur* for a memsahib to go there herself. The market was partly covered and partly open. At the gate we got as much change as possible and as many pennies as we could procure. All the goods were laid out in their sections in little heaps which I gathered represented one penny's worth. The coinage for completeness sake is expressed in terms of shillings, which have the same value as the home shilling, and this is subdivided into 100 cents, and ten cents go to a penny. If you buy something worth five pounds that would be priced at 100 shillings and not five pounds. This is the same as the American method. Things like farm produce struck me as being very cheap. Thus a bunch of carrots or turnips would be a penny. A bunch of bananas also a penny. Don't forget that in this country there are roughly two hundred varieties of bananas. I overheard angry words between my sister and a bazaar man one day. When it had ceased I ventured to ask what it was all about. I was told that the day previous she had had seventeen tomatoes for a penny and to-day the price has soared to fifteen for a penny, and that this sort of thing was intolerable. One of the drawbacks is the inevitable monotony in the fish supply, as only one variety of fresh water fish is available, something like a perch. The local meat is not very good, and we had butchers meat sent up from Kenya; that was excellent. We were independent as regards poultry and eggs.

Most people are familiar now a days with the story of Lutembe, the so-called tame crocodile of Victoria Nyanza, as the story has been made into a film. We went to the banks of the lake one day and hired numerous men to sing it out. They went to various parts and made weird noises, and I helped after I got the idea, but nothing happened that day. I have, however, seen the same sort of thing at Kotah in Rajputana, where the singers went into a minaret, and sure enough several crocodile heads appeared and then a great big fellow came out along a cement slope

attracted by a liberal supply of food which had been attached to a rope. I have photos of this, but Lutembe, like the lions, eluded me.

I had an interesting morning visiting the tomb of Mutesa, who was the King, or as he is called locally, the Kabaka. Uganda is a land of diarchy, and it seems to work very well. The present Kabaka has receptions periodically, which all the officials attend, and there is throughout the province a system of native courts apart from the British courts. This Mutesa is buried under a large circular thatched building in an enclosed area. There was no difficulty about our being admitted, and I cannot remember whether we had to pay a little something or not. Once inside it was dark until one became accustomed to the subdued light. There was a sort of central aisle and at the top of this was the tomb. Guarding the tomb was an old woman reputed to be one of the late Kabakas wives. It is said that one is always on guard. The time must obviously come when this source of supply will end.

Around the tomb hung large checked curtains and there were many spears and other trophies.

About this time I fell ill with furunculosis of my external auditory canal, which put me out of action for a few days, and it was worrying as the time was approaching for me to commence the return journey and, as I had intended to stop for a few days at Nairobi, every day mattered. With skilled attention from the ear specialist, Dr. Roberts, and later from Robin Cormack, I was soon all right, but I missed at least one important banquet where there was every one of my favourite dishes. Instead I had dinner that night off passion fruit juice sucked through a straw, but when I say that the juice of many passion fruits (cost one penny) was mixed with cream and chartreuse—well, things might have been worse.

And so the day came when I had to say *au revoir* to Uganda to a host of new-found friends, and to my sister and brother-in-law, who had done so much for me and my happiness. I feel that writing these notes is some very small token of my appreciation of this great holiday which they gave me, and I never tire of looking at the collection of photos which I then made.

I left Kampala for Nairobi on the first stage of my return journey to India and reached Nairobi the following day. I met Carles, who had been spending his leave on a farm in Kenya, and he also had had no luck with lion, though he had actually sat up for one.

The Cormacks had a very nice bungalow on the high ground quite close to the K.A.R. Officers' Mess.

I went all over the Government laboratories which are well built, well sited and of excellent design. Everything is divided into sections and each section worker has a complete unit to himself. It appeared to me in the short time at my disposal to be a most complete organization.

The biggest thrill for me was, however, our visit to the Athi Plain just outside the town. From the windows of the houses can be seen masses of

game and it is not so long ago that lion were actually in Nairobi and they have been heard even more recently. It is difficult to keep flowers going in the gardens on account of the zebra which come right in. It was unnecessary for my hostess to advise me to see that my door in the guest house was firmly closed. The guest house here was a round summerhouse-like affair very comfortable and, of course, with its own bathroom, etc. Nothing did come in. Robin took me the first evening out to the Plain in a big old Rolls Royce which he kept as a luggage car for safari. We were able to go right into the Plain. It was magnificent to see thousands of sleek fat zebra everywhere and often with large numbers of wildebeest accompanying them. The tragedy is that the zebra seems to be so completely useless apart from affording food to the larger carnivora—notably lion. They allowed us to come comparatively close for they have never been shot over here. The boundary of the preserve is the road which runs quite close, and it is said that if somebody comes along with a gun the game scamper immediately across the roads into the preserve.

I had the good fortune to get quite close to a big herd of eland—most graceful of antelope—and we circled around them in the car which puzzled them a little. It was interesting to see once again how the male shepherded the females off and brought up the rear. In a sort of nullah we came on a troop of hyenas—I suppose a dozen of them. In the distance in the evening light they look much bigger than one usually thinks and with their ears pricked perhaps have a slight resemblance to lion. For sneakiness they must be hard to beat yet they do good work in the jungle in the scavenging line. There were no giraffes about or we could not spot them for it is remarkable how the giraffe can fit himself into the treescape. I had several runs along the road bordering the Plain but I was unable to add very many other varieties of game to the list that I had seen. I must not forget ostriches which I saw in abundance lots of time in different places, some in good plumage but others rather down at the heel.

About seven miles out is a fine hotel called "Brocklehurst" where there is a golf course. Excellent riding is to be had and this I am sure would make an excellent headquarters for a holiday in these parts. In Nairobi itself are two good hotels, "Torr's" and another whose name I have forgotten. Both of these seemed very comfortable. Nairobi is a gay place when things are going well, but at my time depression hung over it. This did not stop the young bloods from coming in from the out-stations on Saturday night to hit the place a crack, and we looked into one of the hotels after the pictures and found things humming. In spite of the depression there seemed to be plenty of money about and it was said that if the settlers would get down to doing things for themselves instead of putting managers and the like into their places that things would have been better. Kenya is very much the "colony." Whether this outlook will survive or not remains to be seen. It is rather fatuous for anyone like myself to say very much after such a short stay, but I have been to several

lectures on the subject of settling in Kenya given by experts to Indian Army officers. I am convinced that Kenya is a grand place to settle for the person with, say, £500 a year. The climate is good. Houses are reasonable and very comfortable and one meets charming people, but to the person of very limited means I think some other place should be chosen. The great advantage is the ease of getting to England for education and other purposes in spite of the fact that Kenya considers that educational facilities are just as good in the colony as anywhere else. That may be but we still have to see the effects of an upbringing wholly in the colony on the second and third generation.

The period of my leave was now nearly up and ten days were still to be used up in getting back to Bombay, so off we went, Carles and I, once more to Mombasa where again we were royally entertained by the McNeills and boarded the "Tirea" for India.

We had a very happy voyage straight through to Bombay.

Although I had little experience of these things it may be of interest to readers to know something about costs and charges. I think that hotels make an inclusive charge of about £10 10s. a week. Drink is expensive as is everything which is imported. It would be impossible to do the safaris which I did without a car. Cars can be hired at all places and are usually good and American. You want a high power car for the roads, if good, have stiff gradients in places especially towards the Belgian border. I think I could have gone into the Congo without a special permit provided I had come out by the same route. The charge at the time I did this trip was 1s. a mile for a car with a driver and 6d. a mile without a driver. A driver is almost essential if one has no knowledge of either the country or the language. Petrol was expensive, but may have come down. A reference to the A.A. would settle this point. I have already said something about shooting charges. I did not shoot. I know, however, that up in the north around Fort Portal where a friend of mine went for his elephant he paid £3 a day for his hunter, and it took him three or four weeks to get his elephant and a buffalo. Around Nairobi the charges would be greater per day, but the time taken might be shorter. It has to be remembered that here is the finest shooting in the world, and that it is to these parts that the rich Americans used to come and so up went the charges. Cinema photography also has increased in popularity and so bigger fees are to be had. The Cherry Martins were just leaving Nairobi at the time I was there having completed one of their big animal films. They said that professionally the animal film was about finished, but there remains the amateur who will keep prices up. It has to be remembered too, that the price of ivory has slumped enormously, and it is now worth very little, whereas some years ago the value of the ivory obtained paid for the game licence and helped the other expenditures.

These then are my reflections of a grand tour and I hope reading them may encourage others to go and do likewise. It has been my

privilege to see a good deal of the world one way or another mainly connected with my army work. Thus I have been up and down the China coast many times and then Japan was only twenty-four hours off and so was duly looked at for a month. I was able to go along the coast of Australia in search of health after an illness and saw something of the big towns and a little of the great country, especially Queensland, and from there it was, comparatively speaking, only a stone's throw to New Zealand and so one seized the opportunity of seeing something of the hot spring country of Rotorua, but to the person who has not had great opportunities of travel and who has to choose carefully and maybe spend carefully, then to him I say, consider Africa and you will not be disappointed, for you will see everything new and nothing of the commonplace.

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### Current Literature.

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MOSING, H. Recherches épidémiologiques sur le typhus exanthématique en Pologne. [**Epidemiological Investigations in Exanthematic Typhus in Poland.**] *Bull. Office Internat. d'Hyg. Publique.* 1937, v. 29, 708-14. [21 refs.]

During, and for some time after, the European war, there were thousands of cases of typhus, relapsing fever and trench fever in Poland. For some years now relapsing fever and trench fever have entirely disappeared, but every year in the winter time many cases of typhus still occur. It has been frequently suggested that the inapparent case of typhus may be a reservoir of the virus and may account for recrudescences and also for the continuation of the disease. The author set himself to examine this thesis. A small village was selected in which cases had occurred every year for some years; in 1936 there were 158 cases out of a total population of 1,000 persons. The blood of cases and suspected cases was inoculated into guinea-pigs and a positive result was only recorded if the animals developed the typical fever, were later proved to be immune to a known typhus virus and in addition gave a positive Weigl reaction; that is, if the serum of the animal agglutinated *R. prowazeki*; this reaction is positive in guinea-pigs whereas the Weil-Felix reaction is invariably negative. Also lice were fed on patients, on convalescents, on contacts and on inapparent cases. At least 100 lice were fed on each person and were then fed on an immune person until *Rickettsia* appeared in the positive cases. Also the sera of the entire population of the village were tested for the Weil-Felix reaction and also for the Weigl reaction (agglutination of *Rickettsial* emulsion). In severe cases when the lice were fed on the patient during the first week of the disease 46 per cent of the experiments were successful and 80 per cent of the lice in the positive experiments were infected. Infected lice may live for six weeks. If the lice were fed on the patient

in the second week of the disease then only 17 per cent of the experiments were positive (ten out of fifty-seven). In very mild cases it was not possible to infect lice even if fed during the first week of the fever. As judged by the infection of the lice the virus is not constantly present in the blood even in the first week of the disease, it may be absent for several hours, even for two or three days, and then again return on the peripheral blood-stream.

All conditions such as famine, overcrowding, reduction of resistance of the individual from whatever cause, multiply the chances of infection of lice.

Batches of lice were fed on convalescents (sixty-eight) immediately after the fever had ceased and also on people who had had typhus some time before (ninety-eight) but in no instance were lice infected. Lice were also fed on 150 contacts of cases, but none of the lice became infected. As a result of the Weil-Felix reaction examination it was found that thirty-seven people who had had no symptoms of typhus, gave a positive reaction; lice were fed on these people, but none became infected.

The author's conclusion is that so far as his work goes in this particular district the inapparent infection case is not a source of infection for lice. It has also been noted that typhus reappears each year in the same district, in the same village, and even in the same house in that village.

D. HARVEY.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

PCHENICHNOF, A. V. & RAIKHER, B. I. Recherches expérimentales sur la transmission du virus du typhus exanthématique des poux malades aux poux sains par voie buccale. Contribution à la solution du problème épidémiologique de la conservation du virus pendant les périodes interépidémiques. [Oral Transmission of Typhus Virus from Infected to Healthy Lice. Epidemiological Deductions.] *Arch. Inst. Pasteur de Tunis.* 1936, v. 25, 402-18, 3 figs. & 1 pl.

The authors fed a large batch of clean laboratory-bred lice on a case of typhus about the tenth day of the disease; these lice were kept for ten days and were then found to be infected with *Rickettsia* and also were proved to be infective for guinea-pigs. An emulsion was made of these infected lice and this was spread on the skin of the leg of an immune person, fresh batches of lice were fed on this person through the patch of skin on which the emulsion was spread; these lice also became infected presumably by the oral route. A control batch of lice were fed on the other limb of the same person, but not contaminated with emulsion; these lice did not become infected (no *Rickettsia*), nor were they infective. Healthy lice were fed on *Rickettsia* emulsion and kept for ten days; these lice were then killed and emulsified and this emulsion spread on the skin and another clean batch of lice fed; these also became infected; this was

done for three generations, over a period of thirty-six days ; the virus was not modified in any way after passage. It is suggested that lice may become infected in this way during an epidemic. D. HARVEY.

*Reprinted from " Bulletin of Hygiene," Vol. 12, No. 11.*

WIDDOWSON, E. M. Mineral Requirements in Human Nutrition. *J. State Med.* 1937. v. 45, 449-58.

From the dietetic point of view, the most important minerals are those of which there is likely to be a shortage. Ca, Fe, P and I fall into this category. In this country Fe and Ca are the ones likely to be deficient. Ca is needed for many vital processes, in bone and teeth building, blood clotting after injury, for maintaining the rhythmic action of the heart. Milk is the most important source, and green leafy vegetables, eggs and nuts. The western diet probably contains a sufficiency of phosphorus, flesh foods of all kinds, milk, eggs and cheese containing abundant supplies. Plant foods, however, except whole cereals, nuts, and legumes, are a relatively poor source of P. Milk is a poor source of Fe, the main sources of which are meat, especially liver, eggs, brown bread and green vegetables. All foods contain small amounts of Cu. Plant foods contain more K and less Na than animal foods. In temperate climates, man can live on animal foods without added salt (milk contains enough Na for the growing baby), but in hot climates or among people working in hot atmospheres, an inadequate intake of NaCl is probably the cause of sub-optimal health. The chief sources of I are the sea, the soil and drinking water. Vegetables and fish contain I, but in those districts in which the intake of I is low, the addition of I to the drinking water and table salt is of value. The availability to the body of the minerals ingested must be considered. Organic Fe is of little value in nutrition as it is not absorbed. Pepsin and trypsin liberate Fe very slowly from hæmatin so that only 5 per cent of it is liberated during digestion. It is thus only inorganic Fe which is of nutritional importance. Little of the iron in muscle meat is therefore available, but nearly all the Fe in liver, eggs, white fish and cereals is inorganic and therefore available. Excess of inorganic P renders Ca unavailable. The masses of fatty acids passing through the gut in sprue and coeliac disease bind Ca as insoluble soaps and prevent its absorption. The Ca of spinach is said to be unavailable because of the excess of oxalic acid present. Both P and Ca may be unavailable because they are present in organic combination. Whole cereals, nuts and legumes contain inositol-hexaphosphoric acid which forms an insoluble double salt with Ca and Mg, this insoluble compound being known as phytin. At least 50 per cent of it is excreted unchanged. The methods of determining mineral intakes and requirements are discussed. The balance of intake and output of a given element is studied on a diet low in the element in question, until the minimum amount of the mineral is found which will just maintain an

equilibrium of intake and output. With children, however, the intake must be found which will allow an optimal rate of storage of the mineral. The milk diet of the infant is poor in Fe and nutritional anæmia is prevalent in the first year of life. Administration of medicinal iron promotes steady growth and protection from anæmia and respiratory infections. 14 per cent of women in the poorest classes of Aberdeen showed a severe degree of anæmia. The Hb content of women can be raised 10 per cent in the course of three weeks by giving 100 milligramme a day of Fe as ferric ammonium citrate. The mineral intake of pregnant women of various working classes was studied and there was found to be a marked decrease in intake of Ca, P and Fe with decreased income, but even those women who could have afforded an adequate diet were taking inadequate amounts of these minerals, not even reaching the non-pregnant requirements.

DOUGLAS C. HARRISON.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

PROC. ROY. SOC. MED. 1937, v. 30, 1039-52 (Sect. Comp. 37-50), 1 chart.

**Discussion on Nutrition and its Effects on Infectious Disease**

[COWELL, S. J.; CHICK, Harriette; HARRIS, L.; EDWARDS, J. T.; CROWE, H. W.; BACHARACH, A. L.; WILSON, C.].

In this symposium on the relation between nutrition and infectious disease, Professor S. J. Cowell discussed the types of investigation into the problem: (1) the attempt to correlate incidence and course of infections with characteristic diets of different races, social groups or institutions. Conclusions from such investigations were that in a certain malaria epidemic which had been studied the mortality-rate would have been lower and the convalescence shorter had the diet been better; that there were far more admissions to hospital for bronchitis, tropical ulcer and malaria among the cereal eating tribes in East Africa than among the meat, milk and raw blood eating tribes; that poor children in Newcastle were eight times as liable to contract pneumonia and bronchitis as well-to-do children; that the high death-rate from dysentery in East African prisons was strikingly reduced when the dietary was improved. On the other hand, one worker found no relation between diet and incidence of bronchitis in children. (2) Attempts to determine the effect on the incidence of infections of changed diet of a whole population. The increased incidence of tuberculosis towards the end of the Great War was thought to be due at least partly to food restriction, although the influenza epidemic of 1918-19 appeared to ravage the well-fed troops as well as the less well-fed civilians. In Christ's Hospital no correlation between colds and febrile chills and dietary changes could be observed, although septic infections of the skin were more common when the diets contained more sugar. (3) Attempts to find the individual food factor responsible for resistance to infection. Severe deficiency of vitamin A is always associated with bacterial invasion



of laboratory animals. Some workers report increased susceptibility also in man in vitamin A deficiency. But increased resistance has in general not been conferred by large doses of vitamin A to individuals who showed no deficiency of this vitamin. There is some evidence that deficiency of the B-complex leads to certain kinds of infection in infants. Vitamin C plays a part in determining the resistance of guinea-pigs to tuberculosis. Infection of the respiratory tract in infants with nutritional anæmia is twice as high as in those infants who have been protected by an additional source of iron. Dr. Harriette Chick: In the case of chronic infections improved diet seems to be beneficial, e.g. infective conjunctivitis, rarely observed among well-situated children, was common in Poor Law Schools, but now, with good diet in these schools, was rarely seen. Dr. L. J. Harris had observed an extra need for vitamin C in infections as evidenced by a sudden drop in C excretion during colds and influenza. In juvenile rheumatism and surgical tuberculosis in children there was marked unsaturation of the tissues with vitamin C. Dr. J. T. Edwards gave results on rats, guinea-pigs and hedgehogs which showed that these animals were far more resistant to foot-and-mouth disease when *under* fed than when well fed. The quicker their metabolism, the more susceptible they were to disease. The most susceptible animals were those in the prime of life and in prime condition. Dr. H. W. Crowe had observed that vitamin-deficient rabbits whose tissues were in poor condition resisted arthritis, while healthy rabbits were susceptible. Mr. A. L. Bacharach stated that sub-saturation of vitamin C existed also in benzene poisoning and in lactation and pregnancy.

DOUGLAS C. HARRISON.

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## Reviews.

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MINOR MALADIES AND THEIR TREATMENT. Seventh Edition. By Leonard Williams, M.D. London: Baillière, Tindall, and Cox. 1937. Pp. xiii + 439. Price 10s. 6d.

This well-known little book has reached its seventh edition and therefore needs no introduction to the medical world. Much has been deleted and substituted throughout, and in particular it is observed that the chapters on "Advancing Years," and "Some Drugs and Their Uses," have been almost entirely removed and replaced by chapters on "Minor Dietetics" and "Remedial Measures" respectively.

This book is scarcely suitable for medical students because it fulfils its claim to be egotistical and in our view does not, for this reason, contain that "average" so necessary for examinations. Medical practitioners of mature mind, however, will derive much valuable information and not a little amusement from a perusal of its pages.

In the matter of prescriptions, of which many are given, it is noticed they are not expressed in the manner recommended by the recent editions of the "British Pharmacopœia." There are one or two glaring typographical errors such as *Albuminaria* and *balledonna* which will, no doubt be corrected in the next edition.

DIXON'S MANUAL OF OSTEOLOGY. Second Edition. Revised by E. B. Jamieson, M.D. London: Humphrey Milford, Oxford University Press. 1937. Pp. x + 465. Price 21s. net.

This volume of 465 pages has the title of "Manual of Osteology" and is intended for the use of junior and senior students. It certainly is a first-class book on osteology, but it also contains a good deal more than this, and frequent reference is made to structures attached to bones or otherwise related to them and so constitutes an excellent introduction to the study of anatomy.

The diagrams are clear and numerous and there are also many radiograms which are most helpful. An interesting and useful feature is the insertion of the meanings of the Greek and Latin words from which the names have been derived.

An excellent book for those commencing the study of anatomy and also for the senior student.

Professor Jamieson is to be congratulated on his revision of Professor Dixon's well-known book. F. W.

WHEELER AND JACK'S HANDBOOK OF MEDICINE. Tenth Edition. Revised by John Henderson, M.D., F.R.F.P.S.Glas. Edinburgh: E. and S. Livingstone. 1937. Pp. xvi + 703. Price 12s. 6d.

This well-known handbook has been widely used for over forty years by students seeking descriptions of diseases containing in brief form sufficient information on the different aspects of each subject to meet the requirements of qualifying examinations. For their purpose the incorporation of many diagnostic tables and notes on anatomy and physical examination enhance the usefulness of the work. A close perusal will evoke much admiration for the wealth of information contained in its pages.

The present author reminds us in the preface that the work is only a Handbook of Medicine and makes no claim to being a textbook. Be this as it may, we believe that there must still be many students of systematic medicine who regard this work as their chief mentor and friend, and for this reason short descriptions of such conditions as thromboangiitis obliterans and congenital heart disease might be incorporated.

The account of cestode infections is rendered somewhat confusing to the student by the different uses made in the text of the term "scolex." On p. 258 it is stated that the encysted larva of some tæniidæ is called a

"scolex" and that in some this is known as a "hydatid," in others as a "cysticercus," whereas on p. 264 the term "scolex" is used to indicate the head of the larva. The head of larva or adult is the accepted modern use of the term.

J. B.

REGISTER FOR RECORDING PURCHASES AND SALES OF DANGEROUS DRUGS.

Bristol : John Wright and Sons, Ltd. London: Simpkin Marshall, Ltd.  
1937. Price 3s. 6d.

This small book of dimensions 5 inches by 8 inches by  $\frac{3}{8}$  inch contains convenient forms for recording the purchases and supplies of dangerous drugs. The recording of supplies may be entered in detail individually, or the alternative method of reference to a day or prescription book folio, permissible under the Dangerous Drugs Act, may be used. The separate parts of the register required under regulations to be used for each class of drugs are in different coloured paper, and can be immediately found by the use of a convenient marginal index. The book is prefaced by Extracts from Regulations made under the Dangerous Drugs Act, 1920.

J. B.

DISEASES OF THE SKIN (a manual for students and practitioners). Fourth Edition. By the late Robert W. MacKenna, M.A., M.D., Ch.B.Edin. Revised and enlarged by Robert M. B. MacKenna, M.A., M.D.Camb., M.R.C.P.Lond. London: Baillière, Tindall, and Cox. 1937. Pp. xiv + 558. Price 20s.

The Fourth Edition of MacKenna's "Diseases of the Skin" has been brought out by Dr. R. M. B. MacKenna, a son of the original author, who died in 1930.

The fact that a fourth edition follows so closely on the third edition, which was published in 1934, is an index of the demand for this popular work.

Many sections of the book have been revised in the light of recent additions to our knowledge of skin conditions; a note has been added on the use of toxoid, a preparation whose value is admittedly still *sub judice*. A description of the condition "erythrocyanosis frigida crurum puellarum," which has been added to this edition, contains a grammatical error where the singular noun "area" is used with a plural verb. The diagrams and coloured plates are unchanged, and excellent.

Army medical officers will particularly appreciate the addition of an article on "Prickly Heat," which has been introduced into this edition, and which is the most common skin disease afflicting Europeans serving in the Tropics.

The price of the book has been kept relatively low, so that it is considered to be excellent value for the money (20s.).

The book is recommended to be included in military hospital libraries, not only for the benefit of the general duty medical officer but as an aid to the Service dermatologist.

J. M. E.

**OBESITY : A PRACTICAL HANDBOOK FOR PHYSICIANS.** By W. F. Christie, M.D. London : William Heinemann (Medical Books), Ltd. 1937. Pp. xii + 204. Price 12s. 6d.

The book is arranged in three parts. In Part I the author deals with fat and its causes, describes the clinical features of the adipose and discusses the diagnosis and prognosis in the various types of adiposity.

He considers that fatness is largely due to excessive intake often aggravated by an unsuitable selection of food.

Part II deals fully with treatment and gives detailed instructions concerning the arrangement of reducing diets to act either rapidly or slowly.

The question of drug therapy is also considered.

Part III contains weight and food value tables, the latter being especially of value when low calorie diets are being arranged.

This book should be useful to those interested in this subject.

A. G. B.

## Notices.

### "WELLCOME" BRAND CALCIUM MANDELATE COMPOUND.

THE introduction of "Wellcome" Brand Calcium Mandelate Compound by Burroughs Wellcome & Co. represents an important advance in mandelic acid therapy for urinary infections. Calcium mandelate possesses many advantages over the ammonium and sodium salts hitherto used, most notable, perhaps, being its entire freedom from the nauseous taste which characterizes the soluble salts of mandelic acid. In the degree of urine acidity produced, it is equal to ammonium mandelate and superior to sodium mandelate, while digestive disturbances following its administration are negligible.

"Wellcome" Brand Calcium Mandelate Compound is a suitably flavoured powder, of which 4.4 grammes (the normal adult dose) is equivalent to 3 grammes of mandelic acid. It is issued in bottles of 125 grammes, with a measure and a supply of test papers.

### COMMANDANT, OFFICERS' CONVALESCENT HOME, OOTACAMUND.

APPLICATIONS are invited for the post of Commandant of the Officers' Convalescent Home at Ootacamund from retired European officers of the Indian Medical Service, or Royal Army Medical Corps.

The terms of the appointment are :—

(i) Salary of Rs. 300 per mensem, in addition to retired pay plus free quarters, lighting, fuel and board, for himself and his wife, who will assist him.

(ii) The tenure will be for so long as the officer's services are required and will be subject to three months' notice on either side.

(iii) The officer will normally be required to vacate the appointment on attaining the age of 57 years. An extension for a specified period may, however, be granted.

(iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorized representative shall be the sole judge.

2. Applications should be addressed to the Director of Medical Services in India, Army Headquarters, Simla, and should reach him by March 31, 1938, at the latest. The selected officer will be required to join the appointment by April 15, 1938.

### EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a *nom-de-plume*.

All Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.

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# Journal of the Royal Army Medical Corps.

## Original Communications.

### BODY TEMPERATURE CONTROL AND PHYSIOLOGICAL REACTIONS DURING MUSCULAR WORK IN GAS PRO- TECTIVE CLOTHING.

BY MAJOR G. P. CROWDEN, D.Sc., M.R.C.P.,

*Royal Army Medical Corps, T.A., University of London Officers' Training Corps.  
Reader in Industrial Physiology, University of London, London School of Hygiene and  
Tropical Medicine.*

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#### INTRODUCTION.

The balance between body-heat production and loss to the environment, which is essential for comfort and for the continued performance of muscular work, is readily maintained under ordinary climatic conditions met with in England by heat-loss due to radiation and convection and, to a lesser extent, by the evaporation of sweat. Ordinary clothing, being permeable to air, facilitates loss of heat by convection and evaporation, but gas protective clothing by virtue of its air proofness and pattern not only limits heat-loss by convection but almost completely prohibits loss by evaporation. When gas protective suits of oiled silk or oilskin are worn during the performance of muscular work, body-heat progressively accumulates as loss by radiation and convection from the outer surface of

the garments is insufficient to balance the increased heat production of muscular effort. Under such conditions the subject not only sweats profusely and ineffectively but experiences sensations of intense fatigue and collapse even after a period of muscular work as short as fifteen minutes if the atmosphere is fairly warm. Body temperature and pulse-rate rise excessively and capacity for muscular effort rapidly declines.

The laboratory experiments and field tests covered by this investigation were designed to determine the temperature levels and gradients between the skin and layers of clothing worn and to assess, by observation of physiological reactions, the effectiveness of various measures calculated to facilitate body-heat loss during the performance of muscular work when wearing gas protective clothing and equipment.

#### SECTION I.—LABORATORY TESTS.

The laboratory experiments were carried out in the air-conditioning room at the London School of Hygiene and Tropical Medicine in which temperatures and humidities corresponding to warm summer weather were maintained in order to make the tests as severe as reasonable. The subject used in these experiments was a healthy athletic young man, aged 23½, accustomed to wearing a respirator and to laboratory work. The temperatures between the skin and various layers of clothing were observed continuously by means of thermocouples fixed in position before the commencement of muscular work. The objects, routine and data of each experiment are given below, but, in order more easily to compare the physiological reactions of the subject when wearing various types of protective clothing, the records of temperature and pulse-rates are combined in one chart (fig. 2).

##### *Experiment I.—28.4.37. Drying Expired Air by CaCl<sub>2</sub>.*

The object of this test was to determine whether the expired air from the respirator could be dried and then used for promoting body-heat loss by evaporation. The expired air was led to a drying, or dehydrating, canister of calcium chloride worn on the back of the subject, and then passed into the protective oilskin suit through a tube opening into the back of the garment at waist level. It should be noted that the protective suit and hood of oilskin worn was of special pattern being totally enclosing up to neck level, including the hands and feet (fig. 1).

Clothing and equipment worn by subject :—

*Ordinary Clothing.*—Wool vest of medium weight ; cotton shirt ; cotton short pants, trousers and wool socks : leather belt.

*Protective Clothing.*—Oilskin single piece suit and hood ; the arms and trouser legs were closed at the bottom and shaped to fit the hands and feet ; the front of the suit was closed with a zip fastener ; no boots were worn as the oilskin of the protective suit covered the feet (fig. 1).

*Equipment.*—Service respirator with tubes connecting the expired air outlet to a metal canister containing calcium chloride, supported by a sling

TABLE I.—EXPERIMENT I.

Date: April 28, 1937.

Place: Air Conditioning Room, London School of Hygiene and Tropical Medicine.

Subject: A. E. Groves. Aged 23½ years. Height 5 ft. 10 in. Weight 10st. 6 lb.

Time		Notes	Temperatures °F.					Pulse and posture
	Mins. from zero		Front between		Back between		Mouth	
		Air temperature: Dry bulb 87° F. Wet bulb 70° F.	Skin and vest	Shirt and suit	Skin and vest	Shirt and suit		
a.m.			(a)	(b)	(c)	(d)	(e)	(f)
11.00		Standing, exhaling through canister	94.0	91.6	100.9	100.5	99.2	92 standing
11.10	0	Started work; 13 minutes step climbing 15 steps of 1 foot per minute. Canister connected to suit	96.1	96.1	103.5	104.1	99.3	112 standing
11.18	8	Canister felt very hot to touch						
11.22	12		97.4	96.7	106.7	104.1	99.4	
11.23	13	Stopped work and stood resting						144 standing
11.25	15	Started work again for 5 minutes						
11.30	20	Stopped work and stood still	98.0	96.1	101.0	100.4	99.6	154 standing
11.32	22	Standing resting						148 standing
11.33	23	" "						144 standing
11.36	26	" "						144 standing
11.38	28	Standing. Canister disconnected from suit but left on back						
11.40	30	Started work for 10 minutes	99.2	97.0	100.7	100.2		
11.45	35		99.4	97.0	100.4	99.9	100.4	
11.47	37	Movements of subject appeared fatigued						
	38	Duster put behind canister						
11.50	40	Stopped work. Stood still. Subject feeling very fatigued	99.7	97.4	100.9	100.7		164 standing
	41							160 standing
	42	Canister removed from back. Subject said he felt easier						156 standing
	44	Standing supporting himself against wall						156 standing
11.55	45	Temperature taken	100.4	97.7	100.2	98.9	101.3	
	48	Sitting on chair						140 sitting
12 noon	50	Sitting, not feeling too fit						136 sitting
		Pulse taken on standing up						164 standing
	51	Pulse standing						148 standing
	54	Expired air from respirator passed into suit. Subject noticed no difference						
p.m.								
12.05	55		99.6	98.0	99.2	97.0	101.0	
12.07	57	Water at 85° F. poured over suit. Subject said he felt much better	97.4	95.5	98.6	97.7	100.7	136 sitting
12.10	60	Outlet of respirator disconnected from suit	97.6	94.9	99.2	95.5	99.6	126 sitting
	62	Wet dusters and sheets of calico applied to back but not front of suit. Subject said he felt eased at once	98.1	95.8	98.6	90.0	99.2	152 standing
	64		98.6	96.1	98.6	85.7		
	65	Subject said he felt better and prepared to work again for 5 minutes. More wet dusters applied to front and arms and legs						150 standing
	67	Room temperature: 87 dry bulb; 70 wet bulb						156 standing
	70	Subject stated that the only thing worrying him was the pressure over his forehead due to the tightness of the hood and elastic bands of the face mask	98.0	96.1	96.7	83.9	99.6	152 standing
12.30	80	Subject weighed. He stated he felt none the worse for experience. He felt "a wreck" until the water was poured over him and until the damp cloths were applied						

on the back; the air exit from the canister was connected to a tube leading through the back of the oilskin protective suit.

As will be evident from the details in Table I, for Experiment I and the graphs in fig. 2a, the drying effect of the air leaving the  $\text{CaCl}_2$  canister



FIG. 1.--Protective suit of oilskin used in Experiments I and II.

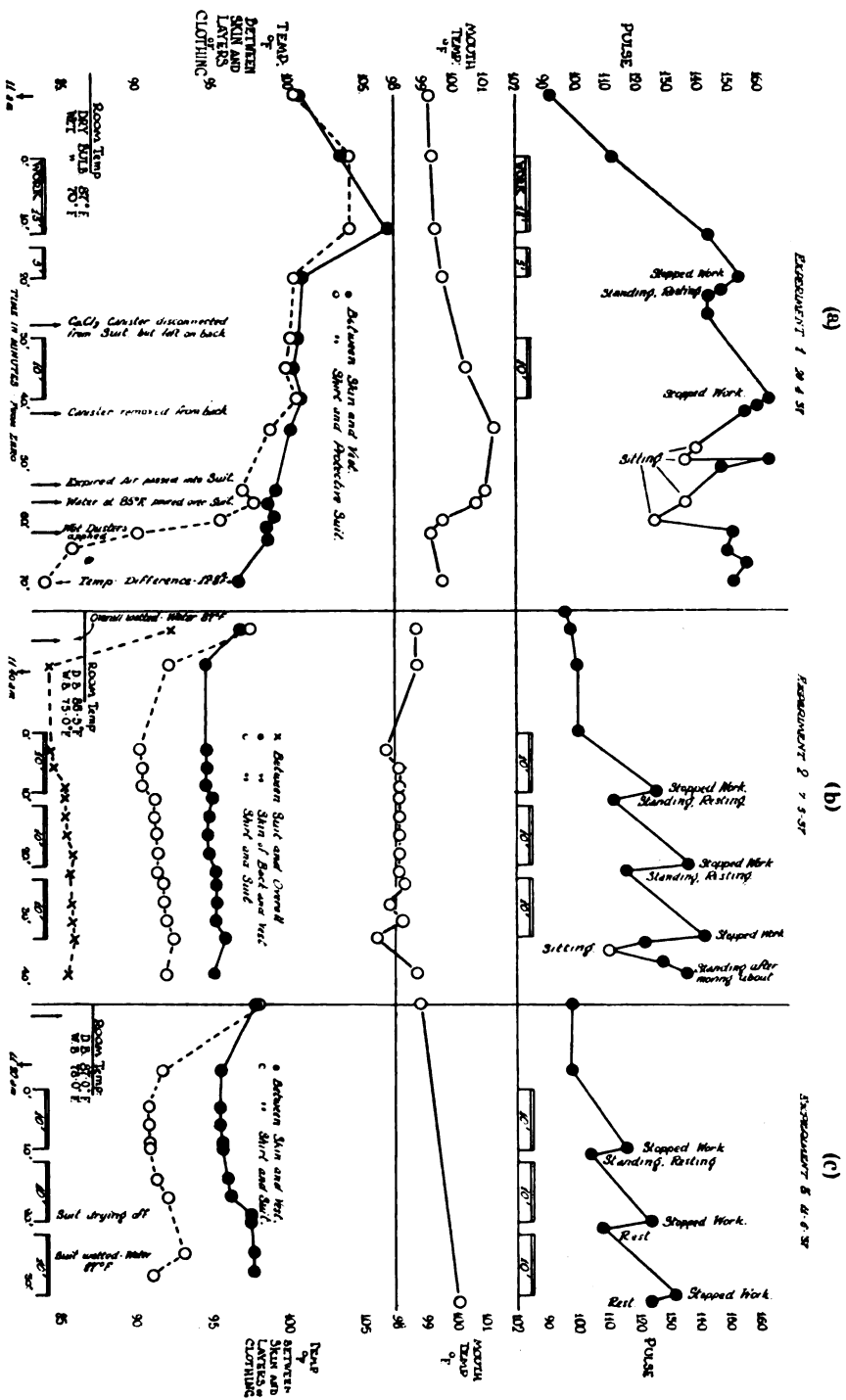
Weight of subject stripped before experiment	..	..	10 st. 5 lb. 8½ oz.
"    "    "    "    after	..	..	10 st. 2 lb. 8 oz.
Loss of weight			3 lb. ½ oz.
Weight of subject clothed and equipped for work			11 st. 9 lb. 5 oz.
			= 163·3 lb.
Work done per minute step climbing 15 steps of 1 foot			= 163·3 × 15 = 2,449 foot pounds per minute
Total work done in 28 minutes	..	..	= 2,449 × 28 = 68,572 ft. lb.
Loss of weight due to sweating	..	..	3 lb. ½ oz.

was counterbalanced by its rise in temperature in passing over the dehydrating agent.

In order to estimate the loss of weight due to sweating and the amount of muscular work performed, the subject was weighed before and after step-climbing. Before weighing, the subject passed urine.

The subject was on the verge of collapse after twenty-eight minutes'

FIG. 2.



work, and in order to increase his heat-loss, water at room temperature and wet cloths were applied to the outside of the protective garment. He immediately felt better and stated that he was ready to work again, but was not permitted to do so. During this experiment the conditions maintained in the air-conditioning room were : Dry bulb 87°F., wet bulb 70°F., relative humidity 40 per cent.

*Commentary on the Results of Experiment I.*—During the first part of this experiment, while the subject was exhaling through the CaCl<sub>2</sub> canister, the temperature of the air leaving the canister rose from 90° to 127·4°F., and the canister felt very hot to the touch. This accounts for the higher temperatures registered on the back until the canister was removed and water and wet cloths applied. Surface wetting was more effective in cooling the back than the front because of the respirator and the greater thickness of clothing overlaps in front. It is worthy of note to record that after applying the wet dusters, the temperature beneath the protective suit at the back fell to 83·9°F., i.e. 3·1°F. lower than the dry bulb air temperature in the room. The room conditions during the experiment were kept at 87°F. dry bulb, 70°F. wet bulb, 40 per cent relative humidity, i.e. hot and dry summer conditions.

This experiment showed that drying the expired air by CaCl<sub>2</sub> and admitting it to the protective suit was worse than useless, but the effect of applying wet cloths to the outside of the protective suit was so dramatic in the instantaneous relief it caused that it proved the value of such a measure for first aid in impending heat collapse when, for fear of contamination with mustard gas, it may not be advisable to remove the protective clothing. This experience led to Experiment II being devised and carried out to test the effectiveness of a wet fabric outer garment worn over the gas protective suit.

#### *Experiment II.—7.5.37. Cooling by Wet Fabric Outer Garments.*

A khaki drill outer boiler suit and hood were worn over the single-piece protective suit as shown in fig. 3. The fabric was thoroughly wetted with water and kept wet during the performance of muscular work.

Clothing and equipment worn :—

*Ordinary Clothing.*—Medium wool vest, cotton shirt, cotton shorts, wool socks, cloth trousers, leather belt.

*Protective Clothing and Equipment.*—Oilskin overalls, as for Experiment I, fig. 1, Service respirator. (No boots as oilskin covered feet.) Outer overalls (boiler suit) and hood of khaki drill, fig. 3.

The air conditions during this experiment were as follows : dry bulb 86·5°F., wet bulb 75°F., relative humidity 56·5 per cent.

Details of the experimental routine followed in Experiment II and the reactions of the subject are given in Table II and in fig. 2b.





FIG. 3 — Khaki drill outer suit worn over oilskin in Experiment II.

Weight of subject stripped before experiment	..	..	..	10 st.	4 lb.	12 oz.
" " " " after "	..	..	..	10 st.	3 lb.	3 oz.
			Loss of weight	..	1 lb.	9 oz.
Weight of subject clothed and equipped for work	..	..	..	11 st.	5 lb.	8 oz.
" " clothed subject immediately after wetting outer overall	..	..	..	11 st.	8 lb.	11 oz.
" " " " on ceasing work	..	..	..	11 st.	7 lb.	5½ oz.
			Mean working weight	..	11 st.	8 lb.
Approximate weight of water retained by wetted overall when worn	=				2½ lb.	
Dry weight of oilskin overall and hood	..	..	..	=	4 lb.	15 oz.
" " " khaki drill outer overalls and hood	..	..	..	=	2 lb.	12 oz.
			Total weight of protective clothing	..	7 lb.	11 oz.
Weight of civilian clothing worn	..	..	..	=	3 lb.	8 oz.
Work done per minute step climbing 15 steps of 1 foot	..	..	..	=	162 × 15 =	2,430 ft. lb.
Total work done in 30 minutes	..	..	..	=	2,430 × 30 =	72,900 ft. lb.
Loss of weight due to sweating	..	..	..	=	1 lb.	9 oz.



TABLE II.—EXPERIMENT II.

Date: May 7, 1937. Place and Subject: Same as for Experiment I.

Time		Notes	Temperatures °F.						Pulse and posture
	Mins. from Zero	Air temperature: Dry bulb 86.5° F. Wet bulb 75° F.	Front between		Back between			Mouth	
			Skin and vest	Shirt and suit	Skin and vest	Shirt and suit	Suit and overall		
			(a)	(b)	(c)	(d)	(e)	(f)	(g)
a.m.									
11.5		Subject put on protective suit and outer overalls							
11.20									84 sitting
11.21									91 standing
11.30		Standing wearing respirator after closure of suit							96 standing
11.33		Temperature before overall wetted	96.8	99.9	96.8	97.4	92.3	98.7	98 standing
11.35		Overall wetted with water at 87° F.							
11.39		Temperature after wetting	97.4	99.3	94.4	92.1	84.2	98.7	100 standing
11.50	0	Started work. 10 minutes. Step climbing at 15 steps of 1 foot per minute							100 standing
	3	Temperature taken	95.6	96.2	94.4	90.1	84.2	97.7	
	6	Overall hood drying a little	96.0	95.7	94.4	90.3	84.5	98.1	
	9		96.0	95.6	94.0	90.3	85.2	98.1	
12 noon	10	Stopped work and rested standing for 2 minutes							126 standing
	11	Temperature taken	96.6	96.5	94.9	91.1	85.2	98.1	
p.m.	11½	Pulse taken							112 standing
12.02	12	Started work. 10 minutes as before							
	14	Temperature taken	96.2	96.2	94.7	91.1	85.2	98.1	
	17		96.2	96.0	94.6	91.2	85.3	98.1	
	20		96.6	95.8	94.7	91.3	85.8	98.1	
12.12	22	Stopped work and stood resting for 2 minutes							136 standing
	23	Temperatures and pulse taken. Hood dry but suit still wet	97.0	96.5	95.1	91.3	85.4	98.1	116 standing
12.14	24	Started work for 10 minutes as before							
	25	Temperatures taken	96.8	96.1	95.1	91.7	85.4	98.3	
	28	" "	96.6	95.6	95.1	91.7	85.6	97.8	
	31	" "	96.6	95.1	95.1	91.9	85.7	98.2	
	34	Stopped work and stood resting	96.8	95.7	95.7	92.4	85.8	97.4	142 standing
	35								122 standing
	36	Resting sitting. Subject said he was ready for another bout of work							110 sitting
	38	Stood up. Subject showed no signs of fatigue							128 standing
	40	Temperatures taken	97.0	96.7	95.0	91.9	85.3	98.7	
	42	Standing after moving about to weighing machine							136 standing
12.48	58	Sitting, pulse							101 sitting

*Commentary on the Results of Experiment II.*—The immediate relief experienced by the subject at the conclusion of Experiment I when wet cloths were applied to the outside of the protective suit, and the production of a material temperature gradient between the layers of clothing worn, indicated that body-heat loss was markedly increased by the evaporative cooling of the air-proof oilskin suit. Two questions were left unanswered by that experiment: (a) Whether the actual sensation of cooling was temporary or permanent? (b) Whether the increased rate of body-heat loss occasioned by maintaining a wet outer surface on the protective clothing would enable muscular work to be performed for prolonged periods without progressive accumulation of body-heat, excessive sweating and risk of heat collapse?

Experiment II was designed to answer these questions by maintaining a wet surface outside the protective suit throughout the period of muscular work. The subject was dressed in the single-piece garment of oilskin outside which he also wore a boiler-suit and hood of khaki drill which retained water. Although he wore this additional clothing, his reactions and sensations recorded during the experiment (Table II) clearly prove that the increased rate of loss of body-heat due to the evaporative cooling of the protective garment was permanent and of such an order that he was able to carry out muscular work in a very warm environment without feeling sensations of fatigue or impending heat collapse. He showed no rise in body temperature in spite of the performance of 72,900 foot pounds of work in thirty minutes.

It should be noted that, before wetting the outer garment, there was hardly any difference in temperature between skin and vest and between shirt and protective suit, but, after wetting, the temperature gradient was 4° to 5°F., as shown in fig. 2b. Between the outer wetted overall and the protective suit the temperature was 1° to 2°F. less than that of the dry bulb temperature of the air in the room. From this experiment it appeared desirable to try and bring the cooling wet surface even closer to the protective layer of oilskin and to achieve this by having the protective garment made of gas-proof material with a wettable fabric-facing adhered to the outside. This development also appeared to be desirable as it would limit the protective clothing worn to one suit.

*Experiment III. 11.6.37. Cooling by Wet Fabric-faced Protective Clothing.*

A protective suit and hood made according to Service pattern but of fabric-faced rubber was used. The fabric surface of the jacket, trousers and hood was thoroughly wetted before commencing work, and again after the completion of fifteen minutes' work. A photograph of a subject wearing the protective suit used in Experiment III is shown in fig. 7 in Section II of this paper which deals with Field Tests.

TABLE III.—EXPERIMENT III.

Date : June 11, 1937.

Place and Subject : Same as for Experiments I and II.

Time		Notes	Temperatures °F.			Pulse and posture
a. m.	Mins. from zero		Back between Skin and vest	Shirt and suit	Mouth	
10.43		Subject resting in room. Air temperature : Dry bulb 84° F. Wet bulb 76° F.			98.8	84 sitting
10.50		Put on protective suit, respirator, hood, gloves and gum-boots				
11.10		Temperatures taken and then suit and hood were wetted with water at 87° F. Room temperature : Dry bulb 87° F. Wet bulb 78° F.	97.8	97.9		98 standing
11.21		Temperatures after wetting completed	95.4	91.6		98 standing
11.24	0	Started work. 10 minutes step climbing at 15 steps of 1 foot per minute. Dry bulb 86° F. Wet bulb 80° F., floor wet with water				
	3	Temperatures taken	95.4	90.7		
	6		95.4	90.7		
	7	Subject " felt fit." Surface of suit felt cool to touch				
	9	Temperatures taken	95.6	90.7		
11.34	10	Stopped work and stood still	95.6	90.7		116 standing
	11	Pulse taken after 1 minute rest				104 standing
	12	Started work 10 minutes as before				
	14	Subject feels fit. Warm but comfortable. Subject evidently alert				
	15	Temperatures taken	95.9	91.2		
	18	" "	96.1	91.9		
	19	Surface of suit drying on back				
11.45	21	Temperatures taken	97.4			
	22	Stopped work and stood still	97.4			124 standing
	23	Subject feeling O.K., warm but comfortable and fit for third bout of work. Sweat in gloves				
	24	Started work 10 minutes as before				
	27	Temperatures taken	97.6	93.0		
	29	Water at 87° F. poured over suit				
11.54	30	Temperatures taken	97.6	91.0		
	34	Stopped work and stood still				132 standing
	35	Mouth temperature taken and pulse			100.1	124 standing
	36	Pulse after 2 minutes, standing resting. Protective clothing removed. Subject stated he could have gone on working for an hour				122 standing

Clothing and equipment worn :—

*Ordinary Clothing* : Cotton singlet, cotton shirt, short pants, flannel trousers, leather belt, thick wool socks.

*Protective Clothing and Equipment* : Jacket, trousers and hood of fabric-covered rubber ; gum-boots and Service respirator.

Weight of subject stripped before experiment	.. ..	10 st. 4 lb.
" " " after "	.. ..	10 st. 2 lb. 12 oz.
Loss of weight		1 lb. 4 oz.
Weight of subject clothed and equipped for work before wetting	= 11 st. 10 lb. 7 oz.	
" " " " " " " after "	= 11 st. 12 lb.	
Weight of water held by fabric of suit and hood	.. ..	2 lb. 7 oz.
Dry weight of protective suit and hood of fabric rubber	.. ..	8 lb. 10 oz.
Weight of gum-boots	.. ..	6 lb. 4 oz.
Total dry weight of protective clothing	.. ..	14 lb. 14 oz.
Work done per minute step climbing 15 steps of 1 foot	.. =	166 × 15 = 2,590 ft. lb.
Total work done in 30 minutes	.. =	2,590 × 30 = 77,700 ft. lb.
Loss of weight due to sweating		1 lb. 4 oz.

The air conditions maintained during this experiment were as follows :  
Dry bulb 87° F., wet bulb 78° F., relative humidity 65·5 per cent.

Details of the experiment are given in Table III and in the charts fig. 2c.

*Commentary on the Results of Experiment III.*—The Service pattern protective clothing consisting of jacket, trousers and hood, made from rubber, faced externally with fabric, which was worn in Experiment III, was more easily put on and of a looser fit than either the single-piece garment of oilskin used in Experiment I or the double garments in Experiment II. Experience has shown that when gas-proof protective oilskin clothing of this pattern is worn during muscular work there is a rapid accumulation of body-heat, excessive sweating and rapid fatigue. It was clearly proved by this experiment, as shown in the records in Table III, that if such garments have an outside layer of absorbent fabric wetted with water, then the increased heat loss due to surface evaporation prevents the accumulation of body-heat. On wetting the surface fabric the temperature between the subject's shirt and rubber inside face of the protective suit fell from 97·9° F. to 91·6° F. and then to 90·7° F. After nineteen minutes' work it was noticed that the fabric surface on the back of the jacket was drying. After twenty-three minutes' work the temperature between shirt and suit had only risen to 93° F. Then the back was re-wetted with water at room temperature 87° F. In less than two minutes the temperature between shirt and suit had fallen to 91° F.

On the completion of thirty minutes' work step climbing at the same rate as in previous experiments, the subject stated that he could have gone

on working for an hour. Judging by his pulse-rate, mouth temperature and general behaviour it was clear that he was in good condition. The amount of muscular work performed was 77,700 foot pounds in thirty minutes as compared with 72,900 foot pounds in Experiment II, the increase being due to the weight of the gum-boots worn. The loss of weight due to sweating was 1 pound, 4 ounces, as against 1 pound, 9 ounces in Experiment II. The room conditions were more exacting than in previous experiments, namely very warm and humid, dry bulb 87° F., wet bulb 78° F., relative humidity 65.5 per cent.

The subject had previously experienced working in Service oilskin protective clothing and stated that the wet fabric-faced suit was the best he had so far worn from the point of view of comfort.

While it was clear that the subject was in a better condition at the end of work in Experiment III than in Experiment II, it is doubtful whether the clothing worn would have been so effective in its protection against mustard gas. The Service pattern outfit with separate jacket, trousers and hood did not envelop and enclose the subject as completely as the one-piece oilskin garment and outer boiler suit of fabric worn in Experiment II.

#### *Conclusions from Laboratory Tests.*

From the test carried out in Experiment I with the calcium-chloride canister it was evident that, unless some means of drying the expired air without at the same time heating it is possible, this measure is valueless. Moreover, it is questionable whether even if the expired air were dry it would circulate freely enough over the underclothing and skin to cause any appreciable cooling effect.

The fact that so completely enclosing protective suiting as the one-piece suit and hood of oilskin which had also sealed arms and legs, could be worn in comfort during prolonged muscular work, provided an outer wetted overall was also worn as in Experiment II, is of considerable practical importance in regard to both decontamination work in the presence of mustard gas or in the transport of casualties or marching through a heavily contaminated area. In Experiment II, the subject had a high degree of protection from mustard gas, even more than in Experiment III in which an outfit of Service pattern was worn. Probably the Service pattern clothing will give adequate protection against mustard gas, and, if the outer surface consists of a wettable fabric which is kept wet, then there appears to be little danger of heat exhaustion even when performing muscular work in very warm weather conditions. It should be noted that in Experiment III the room air was maintained at 87° F. dry bulb, 78° F. wet bulb, relative humidity 65.5 per cent. Such warm and humid conditions are seldom encountered in the English climate.

The results obtained in these laboratory experiments appeared to justify testing the effectiveness and practical utility of wetted protective garments under field conditions in warm weather.

*(To be continued.)*

## FEVERS OF THE TYPHUS GROUP IN THE BHIM TAL AREA, KUMAUN HILLS, U.P., INDIA.

BEING A REPORT OF AN INVESTIGATION CARRIED OUT INTO THE  
ALLEGED INCIDENCE AND NATURE OF TYPHUS GROUP FEVERS IN  
THE BHIM TAL AREA, KUMAUN HILLS, JULY, 1936.

BY CAPTAIN BASIL BLEWITT,  
*Royal Army Medical Corps.*

### THE AREA AND ITS PEOPLE.

THE Kumaon, or Kumaun,<sup>1</sup> is an administrative division of British India in the north-east corner of the United Provinces. It consists of a large Himalayan tract—the Kumaun Hills—and two submontane strips of forest jungle—the Bhabar and the Tarai—to the south of which are the fertile fields of the Gangetic plain.

The Gagar Range is the chief outer mountain chain of these hills, and forms the southern brow of the Himalayan system in this area. It rises abruptly from the plains to a height of 8,000 feet above sea-level, beyond which the hills descend northwards towards the great snow-clad Himalayan peaks separating British India from Tibet.

Situated in a valley of the Gagar Range, 6,500 feet above sea-level, is the hill station of Naini Tal, the summer residence of the Government of the Province and the Military Command Headquarters, while further back among the lower hills is the large military hill station of Ranikhet.

South-east and 11 miles from Naini Tal, among the foothills abutting the plains, is the lake of Bhim Tal and its valley, 4,500 feet above sea-level, latitude 29° 21' north, longitude 79° 34' east, in the pargana Chhakhata. This is a sub-division of the Naini Tal District and because of its many lakes has been referred to as "the Westmorland" of the Kumaun (Nevil, 1922). The more important of these are Naini Tal, Bhim Tal, Sat Tal, Naukuchhiya Tal and Malwa Tal, all save that of Naini Tal and Malwa Tal being topographically part of the Bhim Tal Valley.

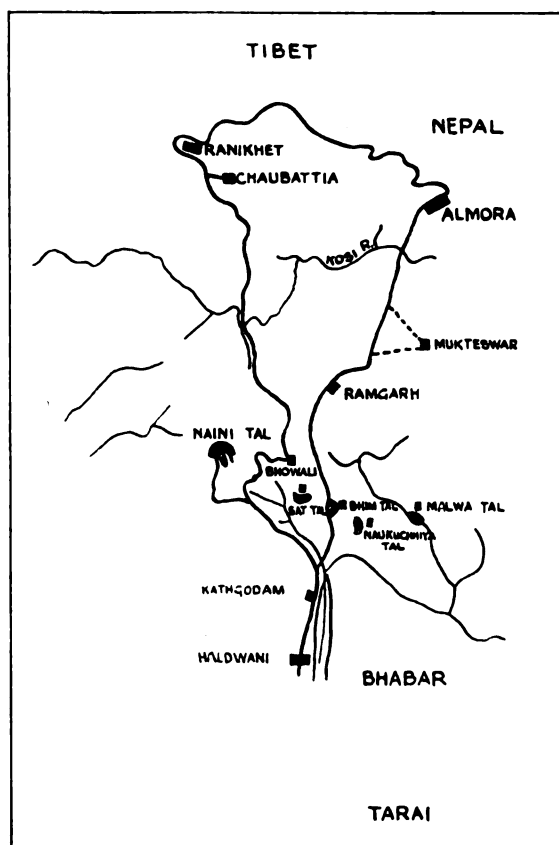
The valley runs a winding course for 5½ miles among the lower foothills in a south-easterly direction. Almost in the centre is the lake of Bhim Tal, while Sat Tal lies in a jungle diverticulum of the upper western side of the valley, 3 miles from Bhim Tal. That of Naukuchhiya is at the extreme lower end of the valley, while that of Malwa Tal lies

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<sup>1</sup> The name is derived from a Rajput Principality now extinct.

outside below the south-east range of hills, in the gorge of the Kalsa River, 9 miles from Bhim Tal.

The floor of the valley is narrow, on an average  $1\frac{1}{2}$  miles wide, with a sharp descent from Bhowali, which lies above and outside it, for two miles, where it expands into a wider flat swampy area down to Bhim Tal, and swinging eastwards from here continues on to Naukuchhiya, where it ends at the lake surrounded on three sides by hills with thick oak woods



coming down to the water's edge. The upper end provides an indifferent pasturage for cattle, and is apparently unsuitable for cultivation, but lower down in the neighbourhood of Bhim Tal and Naukuchhiya excellent pasturage is to be found and cultivation is more in evidence.

The surrounding hills are precipitous, covered in the main by low jungle scrub, but the upper reaches are generally densely wooded, while lower down, towards the valley basin, scrub predominates, creeping into the area of cultivation and habitation, and in parts threatening to envelop it.

The principal approach to the valley is by the old Ramghar-Almora bridle path from Kathgodam, the railway terminus at the foot of the hills, a distance of approximately seven miles along a precipitous narrow hill path which only permits of transit on foot or horse.

The natives of these parts are essentially nomadic, whole villages and their cattle migrating annually to the plains with the onset of the cold weather, returning to their hill villages at the commencement of the hot weather. These migrations, together with the perpetual downward and upward flow of pilgrims and other travellers in the hills along the Ramghar-Almora bridle path to the temples of Hardwar in the plains and the shrines of Garhwal in the hills, produce an extremely fluid population. The annual fair in July at Bhim Tal is one of the largest in the district, and results in a considerable influx from other parts. Such migrations and interminglings have no doubt a considerable epidemiological significance, the extent of which is difficult to appraise, but they probably explain the various outbreaks of disease which occur from time to time in the area, and must be borne in mind in their study.

The principal villages in the Bhim Tal Valley would appear to have a definite endemiological interest in connexion with the present studies, and as such must be briefly referred to. As would be expected they have grown up around the lakes from which they derive their names.

Foremost among these is the village of Bhim Tal, a second class hill station with two small hotels and the summer residence of the Maharaja of Jind. It is divided into two parts, one at the upper and one at the lower end of the lake. The former is the larger, and situated on a quasi swamp, the lake being dry at this point for some eight to nine acres and covered with ideal pasturage, frequented at all times by large herds of cattle, and is popular with visitors for picnics, etc.; the latter at the lower end of the lake abuts on the forests where the Ramghar-Almora bridle path from Kathgodam enters the valley. This has been referred to as the "jungly" part of the village (McKechnie, 1913), and is associated with the typhus epidemic of that period and certain other outbreaks of disease. A Boer prisoner of war camp was established close to the village in 1902, and was maintained until the end of that war. There is an unconfirmed legend of an outbreak of typhus among the prisoners during their sojourn at the camp. Again in the European war it was used for similar purposes and in the past has been a frequent site of military camps.

The village of Sat Tal lies in the Sat Tal estate. This, once a Government tea plantation, has now become the property of an American Missionary, who has converted the large estate bungalow into an Ashram (summer college) for missionary students, etc., from the plains. There is in addition a small number of bungalows occupied by those associated with the college. The entire area is dense forest jungle and maintained as a bird and animal sanctuary. It was in these bungalows that the typhus cases in Sat Tal in 1913 occurred.



There is little to note about the village of Naukuchhiya. Along the southern margin of its lake is a large bungalow—The Manse—which has been associated with certain cases of typhus in the past and must be referred to later.

Malwa Tal village lies in the deepest forest jungle in the now dry basin of the lake, through which the fast rapids of the Kalsa river flow. It is frequented by big game hunters and possesses a good inspection bungalow which is associated with one case of typhus in an Army officer. The area is reputed to be unhealthy, but in what respect or on what grounds could not be ascertained. As it is only 2,300 feet above sea-level the climate is hot and humid and one may infer that malaria is rife.

The climate of Bhim Tal Valley might be described as a cold winter and a mild hot weather, the temperature rarely rising over 80° to 85° F., with a full monsoon period from mid-June to the end of August, during which a very high rainfall occurs. Towards the end of the monsoon the relative humidity is high, producing a hot enervating climate. In this humid tropical atmosphere coarse green vegetation springs up so to speak overnight and the entire insect and arthropod world takes on a renewed and vigorous life.

#### HISTORIC REVIEW OF TYPHUS IN THE AREA.

Continued fevers of an enteric type would seem to have always been prevalent in the Kumaun Hills. The increasing incidence of these fevers among Europeans, especially in the Bhim Tal Valley, resulted in an investigation into the "Carrier Problem" in 1912 by Captain Howlette, R.A.M.C., of which he could find no evidence. In 1913 Major McKechnie, I.M.S., conducted an investigation into the alleged prevalence of "Enterica" in the Bhim Tal area. He arrived at Bhim Tal in July and remained in the district until October of that year when he submitted a report to the Government of the Upper Provinces with the following conclusions:—

- "I. Typhus is endemic in the Kumaon, usually subvirulent when it is called 'Jhar,' when virulent it is called 'Sunjhar.'
- II. Europeans contract it from the natives and sometimes die of it.
- III. Typhus is the chief danger to the health of the Europeans in Bhim Tal and Sat Tal.
- IV. It has previously been diagnosed as typhoid or something else.
- V. There is more typhus among Europeans in Sat Tal than Bhim Tal.
- VI. The vector is probably not a dipterous insect but a human verminous ectoparasite (e.g. fleas, lice, or bugs).
- VII. The conclusion that 'Jhar' is typhus is based on exclusion, clinical observation and inductive reasoning.

"It requires the further support of the experimental method. The far-reaching importance of the subject *per se*, and in relation to the still obscure fevers of India, demand that experiment be applied to its elucidation."

In order that the reader may be acquainted with the facts upon which

these conclusions were based the following details of the McKechnie Investigation are given.

During his sojourn in the Bhim Tal there occurred what can only be regarded as an epidemic of a continued fever affecting the natives in the main, but also Europeans, the details of which after Short and D'Silva (1936) are given in Table I.

TABLE I.				
Locality	No. of cases	Time of year	History of vector	
Bhim Tal and Sat Tal ..	13	May-Oct.	Nil	
Sat Tal .. ..	15	Unknown	Nil	
Bhim Tal.. ..	4	May-Oct.	Nil	

The fever was known in the district as "Jhar" and "Sunjhar", both Hindi words, the former meaning "a paroxysm of fever" and the latter "a burning fever." Though bearing a strong resemblance clinically to an enteric infection it differed from the accepted "Enterica" syndrome in certain features :—

- (1) The sudden onset with high fever and its equally rapid termination by crisis on the ninth to the fourteenth day, followed by immediate recovery of the patient.
- (2) The appearance of a profuse macular erythematous rash extending all over the body on the fourth to the fifth day.
- (3) The presence of a peculiar "mousey odour from the patient."
- (4) The failure to isolate an enteric organism from the blood.
- (5) Persistently negative Widal results.

McKechnie had arrived in the area convinced of the enteric nature of the fevers and despite the evidence to the contrary on investigation he was reluctant to abandon this hypothesis. The suggestion of typhus, made by a medical subordinate, he refused to consider on epidemiological grounds, and by exclusion he felt justified in eliminating malaria, dengue, sandfly and cerebrospinal fever. Eventually, however, he was forced to consider typhus. It was one of the last cases, a native, which changed his view, and in this connection the following passage occurs in his report : " Having seen her I simply had to revise my notion and then I found that the only thing against my thinking of typhus for other cases was my obsession as to the epidemiology." The obsession being removed he had no further doubts as to its ætiology.

The details associated with Megaw's case are well-known and need only be briefly referred to. He was bitten by a tick while in the Kumaun hills (July, 1916) under circumstances suggesting that he had acquired the tick while picnicing with his wife in the jungles between Sat Tal and Bhowali. Twenty-one days later he developed a fever at Lucknow, clinically resembling McKechnie's cases. His interest was aroused in the ætiology and its possible implications. Papers in connexion with the subject have appeared from time to time in the *Indian Medical Gazette* and other Journals in support and elaboration of his views. In his original papers

he drew attention to the circumstances of his own case and McKechnie's report, in which he concurred, differing however as to the vector. The circumstances associated with his own case, and the analogy with the Rocky Mountain spotted fever, suggesting a tick as the vector, possibly either *Rhipicephalus sanguineus* or *Hyalomma aegyptium*, by one or other of which he believed he had been bitten. Further, he contended that the incidence, while common in the Kumaun, was probably of much more general distribution throughout India. He postulated the existence of a tick-borne typhus group of fevers throughout the world of which the classical example was to be found in the tick fever of the Rocky Mountains, and he contended that time would prove his group to be a larger one than it was at present conceived to be, and would include among others the clinically similar fevers which had recently been described in South Africa, Nigeria, Tunis, and now for the first time by himself in India.

It was natural that the subject matter of these papers should provoke widespread interest, not only in India but throughout the world. The extent of that interest has yearly increased, and in many cases the suggestions of Megaw as to a tick-borne group of these fevers has been confirmed by the experimental method; notably the *Fièvre Boutonneuse* of Tunis and the Mediterranean littoral in which the dog tick *R. sanguineus* has been proved the vector. In India, however, the ensuing twenty-three years have brought little progress in our knowledge of these fevers, due largely to the late application of the experimental method and of serology.

The introduction of the Weil-Felix test and the use in all military laboratories of alcoholized suspensions of the OX strains of proteus as produced by Bridges has resulted in two important advances in our knowledge of typhus in India. Firstly, its wide distribution has been revealed, and secondly, the existence of more than one type of the disease. Boyd (1936), in an analysis of 108 cases among British and Indian troops, defines one clinical serological type—the OX K Type—analogueous with the Scrub typhus of Malay. He infers from this that the vector may be the same. In addition to this he postulates the existence of two other types—one the main antigen of whose virus is an unknown strain of proteus resembling in this respect the tick-borne typhus of America, and the other, the main antigen of whose virus is X19, resembling in this respect endemic typhus. He considers, however, that these two types may in reality be only one. The application of the experimental method has brought even more definite information—Covell (1935-36) has shown that in the Simla Hills there exists a typhus fever which is conveyed to man from rats of the *rattus* group through the agency of the rat flea *Xenopsylla cheopis*. It will be noted that the findings of serology and the experimental method are in close harmony with those in other parts of the world.

The evidence in support of Megaw's tick theory is dependent on case report. Shortt and D'Silva, in an analysis of the 177 cases, the details of

which have been published, find only seventeen with a history suggestive that a tick may have been the vector (Shortt and D'Silva, 1936). In addition to these figures the data from Army sources is of interest. These figures for the past three years have not as yet been published and I am indebted to Colonel J. A. Manifold for permission to include them in this study. (See Table II.) Such, then, is the present position throughout India.

TABLE II.

		B.O.	B.O.R.'s	I.O.R.'s	Tick bite history
1933	..	4	23	19	2
1934	..	1	52	51	0
1935	..	2	19	45	0
Totals	..	7	94	115	2

As regards the Bhim Tal area the effect of Megaw's contentions have placed the valley and its immediate environs in "Coventry" and there has arisen a prejudice against it out of all proportion to the incidence of these fevers, which have been thought to have been contracted in the districts. In this connexion most of the bias has been based on Megaw's contentions, and on a mass of unreliable hearsay. Such records as are available, and they are almost negligible, indicate an extremely small incidence, the details of which will be given later in these studies.

#### PRESENT DAY EPIDEMIOLOGY AND ENDEMIOLOGICAL FACTORS.

##### *The Evidence from the Jind Estate.*

This estate has been the property of the Maharaja of Jind for the past sixteen years; to which he has come yearly with an entourage of some 550 people from the Punjab for the hot weather. Here he remains until the cold weather is well established when he returns to the plains. During his sojourn in the hills much time is spent in fishing and shooting expeditions in the surrounding area. He is accompanied frequently by a large staff and guests, European and Indian, in addition to a number of dogs from his large kennels. It would thus appear that he and the members of his estate, in addition to the many visitors, have been exposed to the maximum chance of infection if Megaw's epidemiological factors are correct.

The physician to the Maharaja, and responsible for the health of all on the estate, has never seen a single case of typhus-like fever among them. Continued fevers have occurred in a limited number of uninoculated sepoys of the state force while in Bhim Tal, and all have apparently been enteric infections.

##### *The Evidence from the Sat Tal Estate.*

This estate belongs to American missionaries, and has been their property for the past six years. To it come a large number of Europeans, Americans, Indian missionaries and students for brief spells during the hot weather, though some of the teachers spend the whole season at the

college. It was in some of the bungalows on this estate that the typhus fevers occurred in the past.

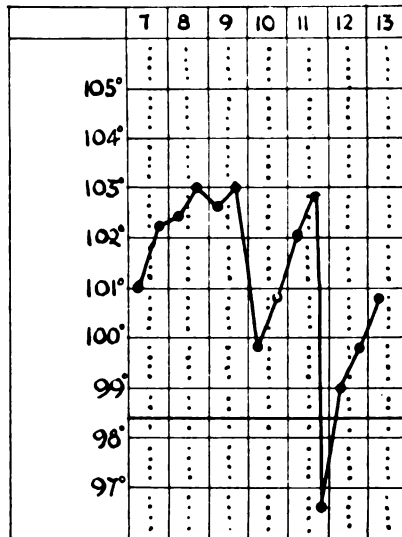
The head of the college who owns the estate and has occupied it for the past six years has never heard of or seen any case remotely resembling typhus fever either among missionaries or students. He said they were all rather amused to see some time ago in a textbook of medicine that they were "famous" and had been mentioned as an endemic area for typhus.

In view of the incidence during the 1913 epidemic involving mainly the natives in the area, it is of considerable interest to record the evidence to-day from the Bhim Tal Hospital. The medical officer in charge of this unit, though himself new to the valley, had never heard of any fever of typhus-like nature among the natives, and the most careful inquiries made through him among the oldest, failed to elicit any evidence of such fevers; "Jhar" and "Sunjhar" had no significance to them. There appeared to be a legend, not well supported, of an outbreak of typhus among the Boer prisoners, and this was associated for no very definite reason with what was referred to as their "bad luck." However, to-day all enjoyed comparative freedom from the ravages of disease. The legend is of interest as offering a hint as to a possible origin of some of the aberrant types of typhus fevers encountered to-day in various parts of India. It is a curious coincidence that Ahmednagar, the only other endemic area for these fevers of which the writer is personally acquainted, was also a Boer prisoner of war camp, and the local cemetery bears witness to a large number of deaths of these men from disease, the nature of which, however, was not at the time inquired into, nor a possible association appreciated. It would be of interest to know the sites of other prisoner camps in India, and their relation, if any, with the present-day typhus incidence. From the foregoing local evidence it is quite clear that the epidemiological picture in the Bhim Tal Valley has considerably altered when compared with the conditions in 1913, as described by McKechnie and Megaw; and indeed one could only conclude that the change has been so dramatic as to justify the assumption that such fevers no longer exist in the area, and to wonder how it has been possible for the stigma and prejudice to exist still. There is, however, another side of the picture, dependent almost entirely on evidence from outside sources, which merits serious consideration.

#### *The Evidence from Outside Sources.*

The evidence consists entirely of a number of cases which developed these fevers shortly after having been in the Bhim Tal Valley and in two known cases while resident there

*Case 9 (Sharp).*—Naukuchhiya Tal, September, 1926: European gentleman, aged 64. Clinically as other cases with rash, etc. Widal negative sixteenth day, Weil Felix negative seventeenth day. Occupied the Manse, Naukuchhiya, when taken ill. Contracted a fever stated to be "tick" typhus, and died. (Banerjee.)



Case 9.—(Banerjee), Naukuchhiya Tal.

*Cases 10 and 11 (Helleyer and Massey).*—September, 1932: Two British Army officers returned to Meerut from a shooting and fishing trip spent together in the Bhim Tal Valley. While there they occupied "The Manse," Naukuchhiya, then empty. Two to three days after their return they were admitted to hospital with a fever clinically resembling McKechnie's cases and serologically proved to be a typhus infection. Both attacks were severe and one case proved fatal. It is stated that the fatal case told a friend before death that he had been badly bitten by ticks on the edge of the lake at Bhim Tal. (Personal letter.) The other case has since stated that he attributed his and his friend's illness to a semi-wild cat which used to lie on their beds at the Manse and "literally shed its ticks" on their beds. (Personal letter.)

*Case 12 (Hawkins).*—September, 1932: An Indian Army Officer was admitted to hospital in Ranikhet, having just returned from a shooting trip in the Bhim Tal Valley (Sat Tal especially). He developed a fever clinically resembling Cases 10 and 11, serologically proved to be a typhus infection which proved fatal. Before death he stated he had been much bitten while in the Bhim Tal Valley by bugs and lice.

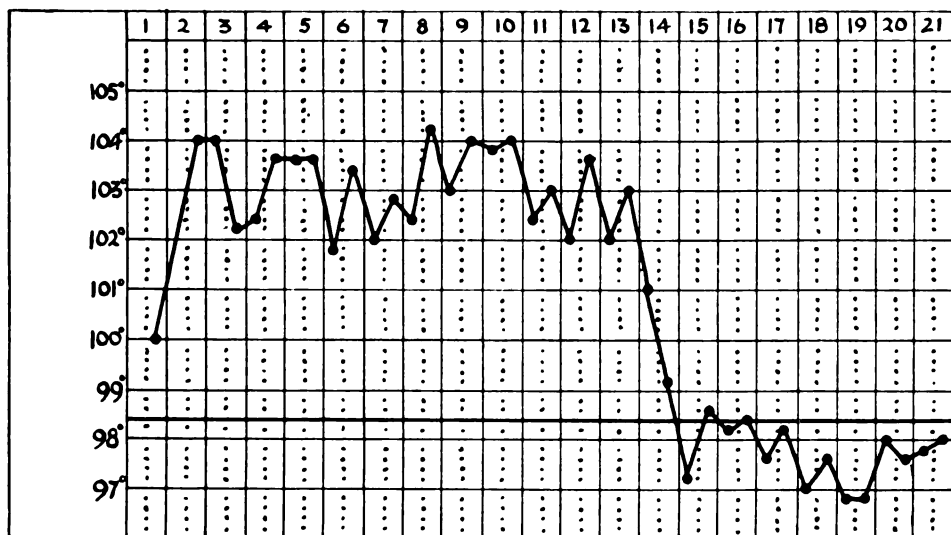
*Case 13 (Starling).*—August, 1933: A British Army Officer returned to Meerut after a short shooting trip in the Bhim Tal Valley. He stopped at the Lodge, Naukuchhiya, while there, except for one night spent at the Inspection Bungalow, Malwa Tal. He developed a fever clinically similar to the other Meerut cases, and serologically proved to be a typhus infection. He states he attributes his illness to "being bitten on the left calf by a tick or other insect in the Malwa Tal-Bhim Tal Area" (personal letter), a *tache*

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*noire* was apparently present at the site. The case ran a severe course, but the patient eventually recovered.

*Cases 17 and 18 (Dauliya and Mirtoolal).*—August, 1936: Two Nepalese were admitted with fever to the Bhim Tal Hospital. Duration fifteen and eleven days respectively. By an arrangement made by the writer the serum of such cases was forwarded with blood smears to the Brigade Laboratory, Bareilly, and it was of considerable interest to learn that though only one examination was possible, the Weil-Felix was positive for OX K in both cases to a titre 1:275 and 1:150 respectively.

In addition to these authenticated cases which have arisen in the following years, it is stated that a certain number of cases have been admitted to the Ramsay Hospital, Naini Tal, with continued fever of some



Case at Naini Tal, August, 1926. School girl, aged 12. Blood culture and stool culture negative. Widal eleventh day negative. Stupor, vomiting, delirium, rash + +. "She smelt like a boxful of dirty socks." Very severe attack but recovery rapid.

form which were considered to be clinically typhus. It would have been of considerable interest to peruse the relevant documents, but this has not been possible. Such details as are available indicate that these cases (number approximately seven) occurred in the post monsoon period, but it would seem that some on serological investigation were of an enteric origin. The majority, if not all of the others, were not serologically investigated. While doubtless some may have been typhus infections, the lack of confirmatory Widal and Weil-Felix tests render the diagnosis at least doubtful, and their omission from this report as more likely to create a true picture of the incidence.

*Typhus Fevers in other parts of the Kumaun.*

Though not of immediate concern to the present investigation, it is of interest to mention the incidence of typhus-like fevers in other parts of the Kumaun close to the area. Louse-borne typhus has, it would seem, always been endemic to the hill people of the Kumaun. In addition to this, however, a number of sporadic cases thought to have been other than louse-borne have arisen from time to time in the Military Hill Station of Ranikhet, but during 1937 there has occurred a sequence of such cases which have been clinically fully investigated by Major O'Meara, R.A.M.C., and would appear to be fevers of the typhus group.

## STUDIES IN THE POTENTIALITIES OF TICK TRANSMISSION.

The collection of material (e.g. ticks) for the present investigation was carried out exclusively in the Bhim Tal Valley, Malwa Tal Area, and the surrounding forest jungles during July, 1936, an area of approximately some fifty square miles.

As localized zones of infectivity in endemic areas are a feature of the epidemiology and endemiology of similar fevers (Woolbach, 1919 ; Blanc and Caminopteros, 1932 ; Parker, 1933, etc.), they might also be characteristic of the fever under investigation, and it was hoped to locate these by a careful study of the details of past cases, thus reducing the necessity to cover so large an area as that in Bhim Tal. Unfortunately essential information was lacking and only vague unsubstantiated generalizations and conclusions could be obtained. Later, by dint of much laborious personal correspondence with alleged cases now in the United Kingdom and elsewhere it was possible to secure information which would have been most valuable and would most certainly have altered the whole trend of the investigation had it been available at the commencement ; unfortunately it arrived in bits and scraps long after the field work was finished and the investigation committed to a definite course.

Thanks to the courtesy of the Park Hotel, Bhim Tal, excellent accommodation for the field laboratory was provided free of charge, and it was thus possible to establish an efficient laboratory for the field work at Bhim Tal. The necessary equipment and animals were brought from the Brigade Laboratory, Bareilly, and though it would have been desirable to employ a very much larger number of animals than were actually used, the comparative inaccessibility of the site made it necessary that the minimum of animals be employed.

(To be continued.)

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## SOME OBSERVATIONS ON BURNS DUE TO EXPLOSION.

BY MAJOR C. B. C. ANDERSON,  
*Royal Army Medical Corps.*

AND

CAPTAIN J. P. DOUGLAS,  
*Royal Army Medical Corps.*

THE following account has been written as a result of our experience in connection with the casualties sustained in H.M.S. "Hunter" and the German battleship "Deutschland," with a view to making some assessment of the value and results of the various forms of treatment. The experience was an unusual one, and is of some importance, especially from the point of view of the Medical Services under war conditions.

H.M.S. "Hunter" struck a mine near Almeria during the afternoon of May 13, 1937, sustaining a large number of casualties. Some of these were taken on board the Spanish battleship "Jaime I," where they received first-aid treatment within a few hours. The remainder were landed at Almeria and received treatment in the Spanish Military Hospital there. H.M. Hospital Ship "Maine" was despatched to Almeria to collect these casualties, and transfer them to the Military Hospital, Gibraltar, where they were admitted on May 15, 1937, forty-eight hours after the accident had occurred.

A total of twenty cases was admitted from H.M.S. "Hunter," suffering mostly from burns of varying degrees and extent, associated with oil-fuel intoxication, fractures and other injuries.

During the evening of May 29, 1937, the German battleship "Deutschland" was struck by two aeroplane bombs while lying at anchor at Ibiza. One of these bombs penetrated two decks in the fore part of the ship, and exploded in the canteen, which at the moment was crowded with ratings. The other bomb exploded on the deck without doing so much damage. The result of this bombing attack was roughly one hundred casualties, most of which occurred in the confined space between decks. Twenty-three men were killed outright, and the eventual death roll amounted to thirty-one. The remainder sustained serious burns, complicated in many cases by fractures and wounds from bomb splinters, etc.

The "Deutschland" arrived in Gibraltar at 6 p.m. on May 30, 1937, twenty-four hours after the bombing, and immediately transferred thirty seriously wounded cases to the Military Hospital.

The following morning a further twenty-five cases were admitted, making a total of fifty-five German cases in all.

In both these incidents, the outstanding feature of the injuries sustained was the high percentage of burns. Of the total of seventy-five cases admitted from the two ships, there were only nineteen in which burns did not constitute the main injury.

It has not been possible to ascertain the actual causes of the burns in either case, but they would appear to be due in part to the flash of the explosion and in part to the subsequent fire. Incidentally it is known that the aeroplane bombs were not of the incendiary type.

It seems, reasonable, therefore, to suppose that similar incidents in the future will have similar results, and large numbers of burn casualties are to be expected.

The problem of dealing with a large number of such casualties under active service conditions on sea or land needs serious consideration.

In the case of H.M.S. "Hunter," forty-eight hours, and in the case of the "Deutschland," twenty-four hours had elapsed between the time of explosion and admission to hospital. This time factor is of considerable importance when one realizes that under ordinary conditions a burn case when seen at once is sterile, and that within twelve hours the *Streptococcus hemolyticus* can be grown in 80 per cent of cases [1] and moreover, it would seem reasonable to suppose that burns caused by explosions are likely to be primarily infected.

In both sets of casualties, in the majority of cases, shock was a marked feature on admission, and most of the burns could be classified as very extensive.

The following table, compiled according to the method of Berkow [2] shows the percentage of the skin area involved :—

Percentage of skin area involved	Percentage of cases
Under 10 per cent	9 per cent of total cases
10 per cent to 20 per cent	24 " " " "
20 " " 30 "	17 " " " "
30 " " 40 "	18 " " " "
40 " " 50 "	10 " " " "
50 " " 60 "	12 " " " "
Over 80 per cent	10 " " " "

#### TYPES OF DRESSING WHICH HAD BEEN USED PRIOR TO ADMISSION.

- (1) Tannic acid.
- (2) Picric acid.
- (3) Bismuth bandages (wismuthbrandbinde).
- (4) Lanoline and cod-liver oil ointment.
- (5) No dressings.

Treatment for shock had been carried out along routine lines, e.g. with morphia, cardiazol, coramine, fluids and warmth. As we have already noted, many cases arrived in a condition of shock with commencing toxæmia, which had no doubt been aggravated by the movement of cases during transport, and the cramped conditions in the ships.

(1) *Tannic acid* had been used only in the "Hunter" cases in the form of gauze compresses soaked in a 5 per cent solution. In a few instances blisters had been removed, but in most cases no complete cleansing or débridement had been attempted. No anæsthetics had been given for

dressings. These tannic acid applications had produced a good coagulum, but patients still had severe discomfort and pain, especially in the region of joints. Splinting of limbs might have relieved this to some extent, but it was impracticable owing to the extensive nature of the burns. Pus had already formed in many cases beneath the coagulum, and evidence of septic absorption and toxæmia was present.

(2) *Picric Acid*.—Only two cases had been dressed with picric acid. Both had extensive burns and were very ill on admission.

(3) *Bismuth Dress (Wismuthbrandbinde)*.—Nearly all the German cases had been primarily dressed with these bandages which had been applied directly to the burnt surface. These were bandages impregnated with bismuth nitrate, zinc oxide and talcum, and according to the maker's instructions are applied without snipping of blisters or other interference.

These dressings had become hard and tight, and much resembled a plaster-of-Paris bandage. Serum had soaked through in many places, and they were already smelling badly. All the patients complained of acute discomfort and begged to have the dressings removed.

(4) *Lanoline and Cod-liver Oil*.—This dressing had been used in only a few cases, and it did appear to give more comfort than did the bismuth dressing.

(5) *No Dressing*.—Some of the slighter cases had not been dressed at all. These were also septic.

#### TREATMENT ON ADMISSION.

##### (A) *Cases from H.M.S. "Hunter."*

All the burn cases had been dressed with tannic acid, except for two which had been dressed with picric acid. On admission, routine treatment for shock was instituted. This included morphia, fluids and glucose, and warmth. All were able to take and retain fluids by the mouth, and a minimum of one pint per hour was given. Elimination was effected by the use of magnesium sulphate.

Areas which showed a good tannic coagulum were left untouched, but in the areas which had not been treated, blisters and dead tissue were removed, and 10 per cent. tannic acid compresses applied.

The original tannic acid therapy had been done mainly without local débridement. Pus was already in evidence under the coagulated areas in most cases. Patients had pyrexia and complained of pain and discomfort, especially over the joints. The result was that in every case, the tannic coagulum had to be removed piecemeal to allow of the escape of pus, and to counteract the increasing toxæmia.

Many of these cases had face burns which had not been treated. These were dressed with plain sterile vaseline applied on a lint mask, and the patients appeared to experience much relief thereby.

Eyes showed conjunctivitis with purulent discharge, and required hourly

boric lavage followed by weak protargol drops, which rapidly cleared up this condition.

A striking feature of these face burns was the rapidity with which they healed, as compared with burns in other parts of the body.

Tannafax was tried in some of the previously untreated areas, but was not satisfactory. As the tannic coagulum was removed of necessity, leaving a raw septic area, it was considered that the kindest dressing to use would be a bland, easily changeable one. For this reason we employed 10 per cent eucalyptus in sterile vaseline, spread on sterile lint, and applied after gentle cleansing of the raw septic areas with weak dettol or equal parts of saline and eusol. This dressing appeared to give the patient a maximum degree of comfort and did not need to be changed more often than once in seventy-two hours.

All the first dressings were done under morphia, and thereafter patients were given pot. bromide, 30 to 60 gr. daily.

The result of these efforts was that in nearly every case the toxæmia had been overcome within four days. Routine examination of urine showed the presence of albumin in four cases, but this disappeared within a few days of admission. Of the two cases from H.M.S. "Hunter" which had been treated with picric acid, one, which had a fractured femur in addition to burns, was dressed with vaseline and eucalyptus after removal of the picric acid, and made a good recovery. The other with very extensive burns, involving at least 50 per cent. of the body area, was cleaned up under gas and oxygen anæsthesia as it was found impossible to do so under morphia. He was treated with 10 per cent tannic acid compresses. In his case the toxæmia was not controlled, severe sepsis occurred and within a week all the tannic coagulum had to be gradually removed. Vaseline and eucalyptus dressings were substituted. Thereafter he made a rapid improvement. Later on, flavine and paraffin (1/1,000) dressings were used on areas with complete destruction of skin.

In most cases the burns were complicated by other injuries, such as concussion, fractures, etc., but no complications arising from burns occurred, except the sepsis and temporary albuminuria.

No deaths occurred in hospital.

#### (B) Cases from German Battleship "Deutschland."

The thirty cases admitted on May 30 were all gravely ill owing to the extensive nature of the burns, severity of shock and associated injuries, such as severe concussion, fractured skull, other fractures, both simple and compound, wounds due to bomb splinters, etc.

These cases were all placed in one ward as they arrived. The general appearance of this ward, full of severely injured German sailors, was a sight which is difficult to describe in words. A few motionless and obviously moribund men; others restless and semiconscious, plucking at

their dressings and moaning with pain; faces burnt, hair singed, eyelids closed by œdema, limbs and bodies swathed in bandages, and an all-pervading aroma of burnt flesh. The many difficulties were multiplied by the language problem, until voluntary interpreters arrived to help.

The moribund cases, three in number, were suffering from burns covering over 80 per cent of the body surface, in addition to signs and symptoms of fractured skull. All these three men died within seventy-two hours of admission. It was not possible to do anything for them, beyond routine treatment of symptoms. Intravenous transfusion was found to be quite impossible in every case in which it would have been of value, due to the fact that superficial veins were not available owing to the extent of the burns.

Shock treatment was instituted in every case from the time of admission.

The amount of individual nursing attention required was a marked feature of this period and threw a very heavy strain on the available staff. It has been pointed out by Peyton Barnes that every burn case should have a special nurse during the first forty-eight hours [3]. This is obviously the ideal to be aimed at, but where large numbers of cases have to be dealt with simultaneously, it is frankly impossible.

On May 31 (twelve hours after the first batch) a further twenty-five injured German sailors were admitted. These were suffering mainly from burns, but on the whole they were of a less serious nature. Nearly all the German cases had been primarily dressed in the "Deutschland" with bandages impregnated with bismuth nitrate, zinc oxide and talcum (Wismuthbrandbinde). According to the maker's instructions on these bandages, they had been applied without any interference to the burn. It was particularly noted that as the patient began to recover from shock he was restless and complained bitterly of pain and discomfort, which was apparently due to the fact that the bandages had "set" like plaster of Paris and had become tight and adherent to the burnt areas, except where serum had soaked through. The areas of leakage of serum were increasing rapidly and becoming septic and malodorous.

Owing to these facts and also to a fear of the possible toxic effects of bismuth applied to such large raw areas, it was considered advisable to remove these dressings. In some cases it was found possible to remove them and clean up the burns under morphia; but all the severer cases were dealt with under gas and oxygen anæsthesia, which was well tolerated. Under this anæsthetic it was possible to do a thorough débridement and dressing. The dressing chosen in all these cases was as before, vaseline and eucalyptus 10 per cent. Our reasons for this choice were as follows:—

(a) The burnt areas were infected, and we had already learnt from the "Hunter" cases that tannic acid applied under similar cases had been unsatisfactory.

(b) The time-consuming factor in such a large collection of cases

precluded the use of tannic acid from a practical point of view, and the situation which was presented to us was the treatment at one time of some fifty cases of seriously burnt men.

(c) We were already convinced that the most important factor in successful treatment was early débridement, and that thereafter a mildly antiseptic dressing which gave comfort to the patient, and was easily changed, was the best type to employ.

It must be remembered that these burns were due to explosion, and that owing to dirt being driven in they do not do well with tannic acid (McCurdy) [4].

The routine treatment instituted from the beginning included glucose and fluids by mouth, one pint every hour, morphia, alopon and omnopon as required, antitetanus serum 3,000 units in all cases, anti-gas gangrene serum in selected cases complicated by bomb wounds, and magnesium sulphate for elimination.

In some cases continuous rectal saline was given, but in no case was it found possible to make use of the intravenous drip method of fluid replacement, for reasons already stated.

When we compared the progress of the "Hunter" cases (tannic) with those from the "Deutschland" (bismuth), our experience definitely showed that the healing time was shorter and the amount of sepsis was less in the latter cases. On the other hand the general condition on admission of the "Hunter" cases was much better than that of the Germans, and this fact can probably be attributed to the efficient anti-shock treatment which was made available during their twenty-four hours in the Hospital Ship "Maine," rather than to the effect of the original tannic acid dressings. Their general condition on admission indeed was better than that of the Germans after the latter had been receiving anti-shock treatment for twenty-four hours in hospital. This fact merely emphasizes the need for early efficient shock treatment.

As already noted, all the cases were septic from the start; original dressings were done under morphia or gas-and-oxygen as required. Subsequent dressings were made easier by the exhibition of potassium bromide backed by morphia when necessary. After all septic tannic coagulum and bismuth dressings had been got rid of, the eucalyptus vaseline was applied on pieces of lint about one foot square, which was changed about every seventy-two hours. As sepsis died down and healing progressed, these dressings were left in situ for longer periods. As soon as areas became dry, the vaseline dressings were replaced by the application of lotio calaminæ. All patients were kept on an expectorant mixture, as well as bromide, on account of irritable cough.

Complications (which are referred to later) were treated as they arose.

There were no deaths in the "Hunter" series. Five cases from the "Deutschland" died, as follows:—

1—Multiple burns and fractured skull	..	36 hours following injury
1—Multiple burns and fractured skull	..	48 hours following injury
1—Multiple burns and fractured skull	..	72 hours following injury
1—Multiple burns and bronchopneumonia	..	7 days following injury
1—Multiple burns and bronchopneumonia	..	12 days following injury

In all fatal cases the total area of body surface involved by burns exceeded 80 per cent.

The following table gives a comparison in the healing time observed in the two series of cases :—

HEALING TIME.			
Percentage skin area involved	Tannic acid	Other methods	
Under 10 per cent	14 days	..	8 days
10 per cent to 30 per cent	20 days	..	15 days
30 per cent to 40 per cent	34 days	..	20 days
40 per cent to 50 per cent	35 days	..	22 days

The complications which we encountered correspond with those enumerated by other observers (Dunbar [1], Strauss [5] and Kuhn [6]), and may be divided into early and late.

*Early complications* were sepsis (in every case), bronchitis, bronchopneumonia and albuminuria.

A remarkable feature was the early evidence of sepsis. It would appear that burns due to explosions are infected from the beginning.

Chest complications occurred in the form of bronchitis in all the more serious cases, nearly all of which had burns involving the thorax and abdomen. Two of the fatal cases with burns extending to over 80 per cent of the body area had frank bronchopneumonia.

Routine examination of urine was carried out from the first day in every case, and albumin was found to be present in nine cases. There was no case of true nephritis, and the albuminuria cleared up very rapidly, except in one case.

*Late complications* were otitis media, 12 cases; erysipelas, 2 cases; follicular tonsillitis and quinsy, 8 cases; furunculosis, 5 cases.

Otitis media ranked highest as a complication, but it must be noted that in every case it was directly consequent on a traumatic rupture of the membrana tympani due to the effects of explosion in a confined space. It is interesting to observe that no cases of rupture of the tympanic membrane or otitis media occurred amongst the men injured in H.M.S. "Hunter." No case of mastoiditis or associated ear complications occurred.

Tonsillitis occurred in eight cases and was probably of the nature of "hospital throat," as it occurred when the burns were in the healing stage and patients almost convalescent.

Five cases of multiple boils occurred in patients who had sustained extensive burns. The skin infection arose after epithelialisation of the burnt areas was complete. The condition was not very resistant to treatment, which consisted of staphylococcal antitoxin, colloidal manganese and dressings of glycerine and magnesium sulphate paste.

Two patients who had extensive burns of the face developed erysipelas after the face burns had healed. They were treated with polyvalent anti-streptococcal serum and sulphonamide P, which appeared to have a dramatic effect in controlling the spread of infection.

The complications observed in our series of cases agree with those noted by other writers. We had no cases of tetanus (all our cases were given prophylactic injection of anti-tetanus serum), scarlet fever, or peptic ulcer.

#### GENERAL REMARKS.

On perusal of recent literature on burns, it transpires that there is no consensus of opinion that tannic acid is the one and only specific treatment. Undoubtedly good results are obtained with tannic acid, but we feel that these satisfactory results will occur only when there is a minimum of primary infection of the burnt area, and after a thorough preparation of the affected tissue by surgical cleansing prior to application of the tannic acid. Moreover we are of opinion that in burns involving total destruction of the skin, tannic acid is liable to be unsatisfactory. It is generally agreed that prevention of sepsis is the ideal to aim at, and this is obviously the important factor in the treatment of these cases. Burns sustained as a result of explosions such as caused the casualties described here, must, we think, be more liable to be septic than those resulting from other causes. Our observations on the results of tannic acid treatment as used in these cases help to bear out this fact, and to show that tannic acid applied directly to a potentially infected burnt surface is not the ideal method.

In some of the cases from H.M.S. "Hunter," where débridement had been carried out over limited areas, the tannic acid results were satisfactory in respect of those areas, which incidentally were not deeper than the second degree.

In this series of cases it may be stated that no primary surgical cleansing had been done, and we found that no matter what type of dressing had been applied, they were all septic. It appears to us that the actual type of dressing chosen is of secondary importance compared with the necessity for early débridement.

It should be realized that under Service conditions, when large numbers of burn casualties occur, circumstances may delay their arrival in hospital for twenty-four hours or longer. We consider that this time factor must be taken into account in deciding for or against the use of tannic acid.

The first-aid treatment of a large number of burns (apart from treatment of shock) is therefore a problem which requires investigation. It is worthy of note in this connexion that in pre-Listerian days, when the routine treatment of burns consisted of cotton-wool bandages (dry dressings), the results obtained showed a mortality as low as that claimed for tannic acid nowadays, and that the mortality from other methods of treatment was much higher (Dunbar [1]).



It has also been pointed out that explosive (infected) burns are unsuitable for tannic treatment (McCurdy [4]).

In view of these observations we offer as a suggestion the first-aid treatment of burns by dry dressings, which has the advantage of preventing extraneous infection, leaving the injured tissue alone and presenting for débridement a burn which has not been covered with chemical dressings or oily substances.

Amongst the types of first-aid dressing used in our series of cases, the German bismuth bandage most nearly approached our suggested dry dressing, but was not by any means satisfactory.

As regards treatment after reception in hospital, the literature seems to be mainly concerned with suggestions regarding numerous types of dressings, of which none has been found to be universally satisfactory. Perhaps not enough emphasis had been laid on the necessity for early surgical interference in the form of débridement.

We do not presume to suggest that the tannic acid method is not an extremely valuable one, but under Service conditions with infected burns and the almost inevitable delay in cases reaching centres where proper surgical débridement can be carried out, it cannot always be the method of choice.

Owing to the factors of sepsis, delay, and difficulty in its application to large numbers of casualties, tannic acid is not, in our opinion, the solution to this problem.

In our experience, gas and oxygen anæsthesia has proved to be an invaluable adjunct to treatment.

We would like to point out that the observations in this series of cases were of a practical nature entirely.

Although the dressing which we adopted (namely vaseline and eucalyptus ointment) has been largely abandoned as unscientific, and is stated to cause excessive scarring, increased sepsis, and long hospitalization (Bettman [7]), its extreme ease of application in dealing with large numbers of cases, and the comfort experienced by the patients, commended it, and we are satisfied with the results it produced.

The conclusions which we arrived at are derived from experience of the results of explosions on board warships.

Whether the same difficulties will be met with on land is problematical, though one must expect large numbers of burn casualties when incendiary aeroplane bombs are used.

The very important factor of delay in reaching hospital should be more easily overcome on land. We visualize the necessity for the organization of special departments in hospitals for the treatment of burns, on the lines of those used for fractured femurs, gunshot wounds of the abdomen and thorax, etc., during the Great War. There does not appear to be a completely satisfactory method of first-aid dressing which is suitable for use on active service. We would like to re-assert that, in our opinion, complete débridement is an essential preliminary to any form of subsequent dressing.

In conclusion we wish to record our thanks to Lieutenant-Colonel J. T. Simson, R.A.M.C., Officer Commanding, Military Hospital, Gibraltar, for permission to send these notes for publication.

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- |                 |             |   |                               |
|-----------------|-------------|---|-------------------------------|
| Head and neck   | 6 per cent  |   |                               |
| Trunk—total     | 38 per cent | { | Anterior surface 20 per cent  |
|                 |             |   | Posterior surface 18 per cent |
| Upper extremity | 18 per cent | { | Hands $\frac{1}{4}$ of total  |
|                 |             |   | Arms $\frac{3}{4}$ of total   |
| Lower extremity | 38 per cent | { | Feet $\frac{1}{4}$ of total   |
|                 |             |   | Legs $\frac{2}{3}$ of total   |
|                 |             |   | Thighs $\frac{1}{3}$ of total |
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“BAJILLED.”

By AL GEBELI.

*(Continued from page 96).*

IV.

The third and last phase in these deliberations begins with the arrival of a political officer in relief of the Consul who had returned to Aden about October 12, after roughly two months of our imprisonment. As the negotiations from now on lead straight to the grand finale when we were escorted back to Hodeida and as there are other things to tell besides hargle barge of high politics, I will now recount some of our personal experiences. Ginger B. was doctor to the Mission but rarely was he called upon to dispense for any of us. He had with him medical and surgical panniers and he opened a dispensary for the local inhabitants in a room downstairs. There is no more useful weapon for peaceful penetration than the doctor and his craft. His influence is far greater than anything the wisest and most diplomatic political officer can bring to bear on the situation. Ginger B. not only served this very useful purpose but became immensely popular as a curer of all ills and won a greater respect than the rest of us put together. A rumour had it that he was a son of the sister of King George and this name he was given by all and sundry. Once when the odds were particularly heavy against our surviving it was agreed by the Sheikhs that “Mabrook must come to no harm; what befell the others was of no matter.” Baghawi was particularly fond of him and would pat him affectionately on the back. Breaking into one of his infrequent smiles, on one occasion and, probably excited by kat, he wound his sinuous arms round Ginger B. who suffered this foul smelling embrace with fortitude for our sakes. One Arab he and I visited in an arish on the border of the village had been shot through the spine and was completely paralysed below the waist, bladder and rectum included. He died. Another was the case of an Arab lad of 20 or so, who accompanied by his old father, was carried down on a charpoy, a distance of forty miles to see the great Hakim. He was covered with a dirty sheet which was black with flies and when we lifted this and examined the wound it was no pleasant sight; seven feet of gangrenous bowel protruded from a six inch gash about the level of the umbilicus and this stinking mass was soon also enveloped in flies. The boy was moribund and we told the father that nothing we could do would be of the slightest good. He would take no refusal. It was not our skill he relied upon, but the will of Allah and perhaps Allah would use us as his instrument to effect a cure. So under duress we prepared to operate,

Ginger B. gave the anæsthetic while I commenced the "Gralloch." It was a rough but speedy performance delayed for a time by his ceasing to breathe and our having to perform artificial respiration. After carving away the foul flesh round the wound, the opening into the abdomen was enlarged and the section of bowel excised, a very excellent end to end anastomosis was effected and the belly closed to hide our crude workmanship. The unfortunate victim was still alive at the conclusion so we gave him stimulants. His father would not hear of his being kept in the room in which we had operated but had him taken, while still unconscious, to a friend's hut. Next morning his corpse was picked up, so we were informed, 200 yards from the hut, whence he had presumably walked, a most incredible thing considering his condition.

It was said that the boy had tripped when running and his gambia, carried generally naked between the lungi and bare belly, had transfixed him, but I rather think there had been a "set to" in his village. Unlike the Gurkha who cleaves with his kukri at the angle between the neck and shoulder the Arab rips from below upwards and the abdomen likely as not is the target. As the old father had intended to give all the credit to Allah had our efforts been successful we wondered if Allah or we mortals would be held responsible for the boy's decease. It was a very interesting point and one that concerned us intimately. There were luckily no repercussions.

One day we witnessed Abu Hade administering justice. The court was held on the open verandah below our building, so we had a splendid bird's-eye view of the whole proceeding. The delinquent, a youth in his teens, was brought before the Sheikh who, seated in the Council chair, cross-questioned him. The crime consisted of the theft of some jewellery. The lad refused to admit his guilt. There was a lot of shouting and wrangling in which all present, and they amounted to a considerable crowd, joined. The boy persisted in defying his jurors, so they tied ropes to his wrists and ankles, pulled him unceremoniously flat on his face on the ground and spread eagled him, his warders forcibly pulling outwards on the ropes. Two others entered the arena, each carrying as instruments of justice the mid-rib of a date palm leaf. Anyone who has studied the architecture of this rib will know that it is triangular in cross section and that the angles are very acute and therefore intensely sharp, moreover it is about six feet long tapering from a thickness of two inches to that of half an inch at the end. At a word from Abu Hade the flagellations began. At each blow the black flesh wealed up and burst, the blood flowing freely. The unfortunate creature squealed and howled, and after each dozen lashes was asked to admit his guilt. It was a bestial sight most sickening to behold, but had no apparent effect on the crowd who looked on unmoved, except his old mother who made as much noise as he did. She tore the

clothes off her person, and seizing a huge stone, raised it above her and kept bumping her poor old head with it, as she ran about shrieking. He stuck it out for about forty strokes before he gave in. His back was reduced to a mass of jelly while the palm stems were split and shredded like straw at their ends. He was dragged to his feet and forced to explain where he had hidden the jewels, after which he was tramped off to the local jail where he would lie in durance vile with irons to his legs. What his wounds would be like after the flies had paid them their undivided attention is a picture too dreadful to contemplate.

The Mosque was straight down the street and we used to watch on Fridays the people dressed in their “braws,” going and returning from worship. The weird chant of the muezzan from the top of the minaret was forever in our ears calling the attention of all good Moslems that the time for prayer had arrived. His voice was the first thing we heard before dawn, and Neda, true to his faith, would rise from his bed, arrange his mat to face the direction of Mecca, and proceed with his devotions.

It was not always the local Saiyid who preached, but whoever it was the usual subject for the sermon was some rude remarks about Kaffirs with special reference to us. In many instances a definite attempt was made to incite the people to destroy us, hip and thigh, and Neda, who was a regular attendant, returned often in a very unsettled frame of mind with a warning to us that something desperate might happen in the near future. One preacher urged that we should not be allowed to remain uncircumcised, and that early steps should be taken to carry this into effect. I had heard from a missionary doctor in Aden that the operation with some tribes was made an occasion for celebration, and was of a particularly brutal nature. I rather think the method here described referred to the Idrisi, a tribe occupying, as I have said, land to the north of Hodeida. The object of the hakim’s attention has reached man’s estate. He seats himself in a hunkering position, holding in each hand a spear, the points of which just touch the dorsum of his feet. Round him in a semicircle are gathered the maids of the village amongst whom is his betrothed. An instrument like a Jew’s harp is used and the superfluous tissue removed with the sweep of a knife which continues its course upwards, cutting a slice of skin from the belly as high as the umbilicus. The operation, apart from its religious significance, is a test of the man’s endurance to pain. Should he, in his agony, jab the points of the spears into his feet and draw blood, he has failed in the test and is an object of ridicule to the female spectators and may possibly run the risk of being rejected by his special choice.

The doctor who told me this said that many times he had to rectify the damage from resulting cicatrization. He thought that possibly this specially elaborate method of circumcision had its origin in an attempt

to keep down the birth-rate of the tribes that lived on the sandy desert where the food supply is an everlasting problem.

This knowledge of the *modus operandi* did not lessen the distress the news Neda brought me from the Mosque.

I was, you see, the only one to which the threat could possibly apply. It would be no day of celebration for me, but like many clouds on the Bajil horizon, this one also faded away.

We were all soon out of condition from the want of exercise, the perpetual heat and the continuous nervous strain under which we lived. Occasionally we went short walks in pairs with two or three armed slaves as guard, but this mild activity was not sufficient, so we asked for a football to be sent up from Hodeida and inaugurated games amongst the sowars and muleteers. The Arabs saw soccer as played by heavy-booted Indians on the hard desert ground for the first time in their lives and roared with delight when the play became especially foul. I apparently elicited a reputation for fleetness of foot, and there had been some betting amongst our guard as to whether I could outstrip one of their members who considered himself a bit of an athlete. The matter came to our knowledge in this manner: we were taking a perambulation towards one of the hills a short distance off, when one of the guard stopped us, and, taking the rifle and bandolier from his mate, suggested that the latter and I should race towards a tree at some two hundred yards distance. I agreed and prepared to do or die. I was bare legged except for a pair of Indian slippers, and the path was sprinkled with loose stones. The Arab promoter got us to our marks and gave the start, and off we went. I got the lead at once, and the path not being wide enough for two abreast, I was at an advantage; yet he kept at my heels for the first hundred and then I let myself go. I had lost my shoes and ran the greater part of the way barefoot. I got home by a good ten yards, and as I eased up at the tree I heard something whizz past me and rattle on the ground. I knew at once what it was and went forward and picked up the dagger and returned it to its owner. He was furious and was even more so when his friends had the opportunity of rubbing it in. The race was witnessed from the village, and the rumour which may have been purposely spread was that I had tried to escape and only by the vigilance and speed of our guard had I been prevented. It was made an excuse for us being held closer prisoners for the next three or four days.

The climax to this unhealthy life as far as I was concerned was a quinsy which lasted for a fortnight, and which for four whole days prevented me from taking a particle of food or a drop of water. Three hesitating attempts I made with a knife at two or three days' interval and only at the third attempt did I succeed in getting the blade home into the abscess. The relief which I still remember so well was immediate and I was able

to eat a full meal within an hour, but the attack left me lamentably weak and toxic.

When I came on this adventure I left two good things behind me in Aden because they were safer there, namely my Hindu servant and my dog. I took on an Arab boy, Mahdi by name, who was recommended to me by the Brigade Signal Officer as being the best camel boy he possessed. On the first occasion when our lives were in danger he offered to keep safe the few hundred rupees I had brought with me and which would undoubtedly sooner or later be stolen by the Sheikhs. I agreed. The next day he appeared with a huge German repeater hidden in the folds of his lungi. With this he swore he would defend me with his life. The next day I missed him and learned he had been persuaded to leave my service for Abu Hade's and that he had lost his heart to a village maiden. I asked Abu Hade to return him forthwith, but this he refused to do. Two or three days later I had to suffer the ignominy of having him as one of our armed guard. He cocked snooks at me from a charpoy on which he sat cross legged with the business end of a rifle pointing in my direction. I went over to show my authority and was at once seized by two hefty black villains who forcibly conducted me to the stair leading to the roof, with the derisive laughter of my former slave ringing in my ears. Later still, when the novelty of his new appointment and the glamour of his love adventure had worn off and when the money he had looted from me had become exhausted, he put out feelers through one or two of his friends to see whether I would consider his returning to my service. My answer was very definite. He could certainly return but only as a prisoner under close arrest; to the last I demanded unconditional surrender in spite of the continued efforts of his plenipotentiaries who in a final effort thrust themselves on me while I mounted on my mule preparatory to leaving and pleading kissed my bare knees. We left him behind. Presumably he would eventually find his way back to his own country.

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## THE TREATMENT OF GONORRHOEA WITH SULPHANILAMIDE.

BY MAJOR O. J. O'HANLON,  
*Royal Army Medical Corps.*

IN August, 1937, a trial of sulphonamide P (Burroughs Wellcome and Co.) as a treatment for gonorrhœa was commenced at the Connaught Hospital, Aldershot. It was very soon apparent that this drug had a lethal action on the gonococcus, and it remained to be ascertained if the minimum amount which would effect a cure could be safely given as a routine treatment. A total of one hundred and one fresh and relapse cases of gonorrhœa and sixteen non-specific cases of urethral infection which have been treated with sulphanilamide and discharged from hospital as cured are considered in this article.

Forty-five grains daily for about seven days was tried at first on fresh and old infections, normal treatment being uninterrupted. This dosage did not effect a cure in any early case, and though all were very definitely improved while taking sulphanilamide, improvement was not maintained after the termination of the course. On the other hand, old-standing cases became rapidly dry and cleared up completely.

There were twenty-six old infections in hospital to whom sulphanilamide in approximately the above doses was given, and whose periods in hospital at the time this treatment was commenced ranged from one to five months. A rapid cure was effected in each case, all being discharged from hospital in an average of seventeen days from the commencement of treatment. Three of these cases required a second seven-day course to effect a cure and two were admitted to another hospital about two months later as relapses; the possibility of reinfection could not however be excluded.

The results thus obtained in old-standing infections were remarkably good and with a dosage smaller than that which is now employed even the most intractable cases, of whose recovery one had almost despaired, became free from all signs and symptoms of gonorrhœa within two or three days.

Forty-five grains daily having been found insufficient for early cases the dose was gradually increased up to the following, which has so far given satisfactory results and has not produced any serious toxic reactions, i.e. twelve  $7\frac{1}{2}$  grain tablets daily for four days followed by nine daily for three days, and six daily for a further two to four days, the course thus lasting nine to eleven days. In order to maintain a constant concentration in the body the drug is given four times daily, at 6 a.m., noon, 6 p.m., and midnight, ninety grains daily being given for the first four days in an endeavour to overcome the infection as rapidly as possible from the commencement of treatment.



With the above amount I have obtained my best results and it is the maximum which I have given, though provided no serious toxic symptoms occur it is very possible that a bigger percentage of successful cases could be obtained by larger doses. Patients vary greatly in their reaction to sulphanilamide, and one can only hope to arrive at a dosage which, while producing no severe ill-effect on the majority will yet be sufficient to effect a large percentage of cures. As all the toxic effects in my cases commenced about the fourth day of treatment, before any large amount of the drug had been taken, it may be that a susceptible subject may be rendered equally ill by a large or small quantity. I do not consider that a course of treatment exceeding twelve to fourteen days is advisable, as provided a sufficiency of sulphanilamide has been given at the commencement, the patient will have been already cured by at least the twelfth day, if not resistant to the drug.

All cases, i.e. gonorrhœa, fresh and relapse, and non-specific urethritis, are treated as follows, in addition to sulphanilamide given as above. Treatment is commenced from admission. Patients are confined to bed on an alkaline mixture and an egg-free "milk" diet, liquids being freely given. A daily evacuation is ensured by paraffin liq. or enema and the temperature is recorded twice daily.

No irrigations are now given to patients while taking sulphonilamide, it having been found that the number of cases relapsing in hospital, after apparent cure, was very much greater if lavage, especially with potassium permanganate, was employed.

Each morning at 6 a.m. patients are taken to the laboratory where, before passing urine, they are examined for urethral discharge and slides prepared. All are seen later by the medical officer, who records the condition of the first urine passed that day and examines the patient for any evidence of toxic effects.

Some twenty of the first early fresh infections were put through a test for cure lasting over ten to fourteen days, and only discharged hospital if all findings had been negative over the test period and for some days prior to it. As it was found that only those who had been irrigated broke down under test, this procedure was cut out and it was thus possible to reduce each patient's stay in hospital by about seven days. When all signs and symptoms of the disease are absent for about a week one can generally consider the patient as cured. His urethra and prostate are then examined and if the findings are negative he can be discharged from hospital. As no relapses have occurred amongst the thirty-eight cases thus dealt with it is considered that this procedure is so far justified. Weekly inspections and examinations are, however, subsequently carried out for two months.

The course of 80·5 per cent of cases was practically uniform and was as follows: By the third day of treatment gonococci had permanently disappeared from the urethral discharge, which sometimes persisted for

two or three more days. It was, however, only a "pinhead" obtained by "milking" the urethra, and contained a few pus and epithelial cells but no organisms, being the result of the urethral inflammation which had not yet completely subsided. In many cases, however, the patient was dry in thirty-six hours, and the urine was clear in all by the third day. All these cases remained dry and made uninterrupted recoveries without complications. None had any signs of gonorrhœa after the first three days in hospital.

The remaining 19.5 per cent of cases were not cured by sulphanilamide; in a few the disease appeared entirely unaffected. Most of these patients, however, progressed in a very satisfactory manner for a few days, becoming dry, etc., but after about a week of treatment a discharge containing gonococci reappeared. Further sulphanilamide had then little influence on the subsequent course of the disease, which assumed chronic characteristics.

An explanation for these failures has not as yet been arrived at. A study of the urine for pH values and their comparison with those of successful cases did not reveal any difference. In view of the possibility that these cases were not absorbing the drug from the alimentary canal, soluseptasine was given intramuscularly but without any beneficial effect. The blood-count of these failures did not show any variation from that of the successes. Though there is a possibility that a strain of the gonococcus exists which is wholly or partially resistant to sulphanilamide, a lack of resistance on the part of the patient is a more likely cause of failure. Efforts were made to stimulate the resistance of these cases by mild pyrotherapy, shock treatment, vaccines, etc., but no definitely successful results were obtained. Some were cured by a second or third course of sulphanilamide given after intervals of fifteen to twenty days. Many were, however, entirely unaffected by these subsequent courses. It has been suggested by some writers on this subject that no further sulphanilamide treatment should be given if the first course fails, and that these patients be then treated on accepted lines. In dealing with out-patients this is probably the better procedure; as however one is considering the treatment of patients kept strictly in hospital throughout the course of their illness under control and observation, I consider that further sulphanilamide treatment should be given after an interval of three to four weeks, as many of those who failed to respond to the first course were cured by a second or third. In the interval between courses the patient is treated on routine lines with irrigation and local treatment as indicated, and efforts are made to stimulate his resistance by vaccines, etc. Recently "Uleron" (Bayer) has been used in a few resistant cases. The results were most promising, and I consider that this preparation should be tried out in all cases not cured by sulphanilamide. Uleron is not on the market at the time of writing.

## GONORRHŒA RELAPSE.

These cases ran a very favourable course under sulphanilamide treatment. The period spent in hospital was markedly reduced. No unfavourable cases were encountered.

## URETHRITIS NON-SPECIFIC.

As might be expected, the dramatic cures experienced in the sulphanilamide treatment of gonorrhœa were not seen when dealing with non-specific urethritis. Though some cases appeared only slightly influenced, the results of the drug treatment in this disease were far superior to those of cases treated on accepted lines.

## RESULTS.

## GONORRHŒA, FRESH CASES.

	Number	Average number days in hospital	Complications— arthritis, epididymitis	Known relapses to date
Cases treated in accordance with the latest plan of treatment as outlined above	38	14.5	Nil	Nil
All cases treated with sulphanilamide from admission. Many were treated on what are now considered to have been unsatisfactory lines.	71	21	Nil	Nil
All cases treated with sulphanilamide from admission :—				
(a) Favourable cases	61	16		
(b) Unfavourable cases	12*	53†		
All cases treated during 1937 with polyvalent vaccine (many were finally cleared up with sulphanilamide on reaching the chronic stage).	82	62	Urethritis 1 Epididymitis 9	10

\* Includes two cases remaining in hospital.

† Does not include two cases remaining in hospital.

## GONORRHŒA, RELAPSE.

Cases treated with sulphanilamide from admission.	7	20	Nil	Nil
Cases treated on routine lines from admission. (Some were finally cleared up with sulphanilamide.)	31	43	Nil	1

## URETHRITIS.

Cases treated with sulphanilamide from admission.	12	13	Nil	Nil
Cases treated on routine lines from admission. (Some were finally cleared up with sulphanilamide.)	55	27	Nil	Nil

## TOXIC EFFECTS.

Cases under sulphanilamide treatment must be carefully observed from the beginning, but provided the drug is stopped on the first appearance of a serious toxic effect it seems probable that no danger need be anticipated. Any intolerance amongst my cases appeared about the third day of treatment, and the first toxic signs may be easily missed unless carefully looked

for. Hæmoglobin estimations and differential white blood-counts were carried out before and after treatment in forty-one cases, and though they all received approximately forty grammes within ten days no evidence of agranulocytosis or other morbid condition of the blood was noted. Patients confined to bed apparently do not suffer from many of the minor ill-effects common in those who have had to be up and about while taking the drug.

Most of my patients seemed to cerebrate slowly for the first few days, and a few complained of giddiness. Two cases of severe headache occurred. Pallor was fairly common. Pyrexia is a sign of intolerance to be always watched for. It is liable to commence at any time during treatment. It is at first unaccompanied by any symptoms and so is liable to pass unnoticed for two or three days. At first the temperature does not exceed 100° F. and disappears in twenty-four hours after the cessation of sulphanilamide. If, however, this pyrexia is overlooked and the drug continued it increases rapidly so that by the third day it may reach 105° F. and the patient appears very seriously ill. This severe condition takes about three or four days to subside provided the administration of the drug is at once stopped. Temperatures of all cases are taken twice daily and treatment discontinued for a time if pyrexia supervenes. It would appear desirable that all cases treated with large doses of sulphanilamide should be kept in hospital and under strict observation, as otherwise unfortunate results might occur which would bring this drug into discredit.

#### EFFECT ON COMPLICATIONS.

There was no means of ascertaining the effect of sulphanilamide on epididymitis, as no case was admitted with this complication and none arose during treatment.

*Arthritis and Synovitis.*—One case of gonorrhœa of a month's standing was admitted with pyrexia, and synovial effusion into both knee-joints. He was unable to stand and was in considerable pain, but there was no involvement of the articular surfaces. Under sulphanilamide treatment the pain, swelling and temperature subsided in a few days, and he was clear of active gonorrhœa in ten days from the date of commencement of treatment. The knee-joints are recovering rapidly. One case had severe arthritis of the knee of one month's standing; the bone ends were involved and the patient was suffering considerable pain. The infection at once cleared up, and though prolonged surgical treatment was necessary before his joint became serviceable he ultimately recovered and was sent home on leave.

*Posterior Urethritis.*—Two cases were admitted with blood in the urine. This condition cleared up completely in a few days and the patients recovered rapidly.

To conclude I wish to stress the following points in connexion with the series of cases treated by sulphanilamide :—

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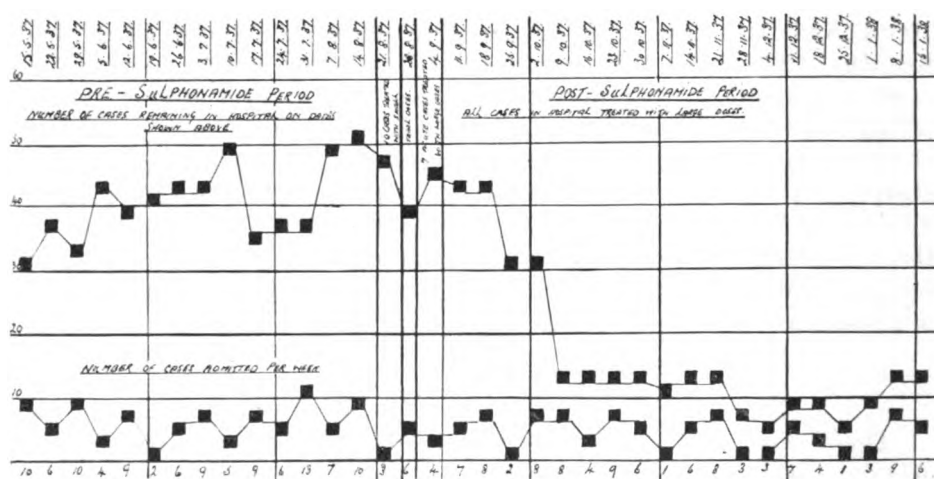
(1) The average period spent in hospital by fresh gonorrhœas has been reduced from sixty-two days to twenty-one days.

(2) No complications have occurred in any case. Even those resistant to the drug have run an uncomplicated course.

(3) There has been a complete absence of relapses in cases treated with adequate doses from the commencement of their illness.

(4) Toxic effects can be controlled by careful observation and appropriate treatment.

(5) The graph shows the marked reduction of venereal patients in the Connaught Hospital as a result of sulphanilamide treatment.



(6) The results obtained with large doses of sulphanilamide are far better than those obtained with smaller doses, cases are cured more rapidly, and the percentage of unsuccessful cases is lower.

(7) The results in my series have been very constant, and provided treatment is fully and carefully carried out, it should be possible to repeat these results indefinitely. It is hoped that in the future means will be found to diminish the percentage of resistant cases.

(8) It has been suggested that sulphanilamide treatment should not be commenced till the disease has been in existence for from ten days to a fortnight in order to enable the patient to develop his natural resistance and thus cut down the number of unfavourable cases. This procedure entails the following drawbacks: (i) Average stay in hospital of all cases is prolonged. (ii) Complications in a considerable percentage of cases would occur before sulphanilamide was given.

In my opinion the above procedure would be desirable did not the disadvantages outweigh the advantages.

(9) Below is a list of all cases of gonorrhœa remaining in this hospital on January 15, 1938, the date on which this article was completed.

Case No.	Date of admission	Remarks
1	22.10.37	Unaffected by sulphanilamide—continues to show gonococci in urethral discharge. No complications.
2	4.12.37	ditto. ditto.
3	30.12.37	ditto. ditto.
4	3.1.38	ditto. ditto.
5	13.12.37	Unaffected by a first course of sulphanilamide. A second course after an interval of fourteen days, during which protein shock therapy was given, has apparently cured the disease.
6	29.12.37	Sulphanilamide was stopped on the second day on account of toxic reaction—pyrexia. Three days later developed epididymitis with much albumin and blood in urine. This condition rapidly subsided. Patient is now dry and progressing favourably on a course of sulphanilamide commenced on 10.1.38.
7	5.1.38	All progressing favourably to date.
8	8.1.38	
9	10.1.38	
10	11.1.38	
11	11.1.38	

Admissions subsequent to 11.1.38, are not considered, as no opinion can yet be formed as to their progress.

The unfavourable cases amongst them have been taken into account in assessing the percentage of those failing to respond to treatment. Cases 6 to 11 have not been considered in my figures as the success or otherwise of their treatment is still undecided.

My thanks are due to Major-General F. D. G. Howell, D.S.O., M.C., K.H.S., D.D.M.S., Aldershot Command, and to Lieutenant-Colonel J. R. Hill, R.A.M.C., Officer Commanding the Connaught Hospital, Aldershot, for permission to forward these notes for publication. I am indebted to Lieutenant-Colonel L. Dunbar, O.B.E., R.A.M.C., A.D.P., Aldershot Command, for undertaking the blood examinations of these cases, and to Cpl. F. J. Hopewell and Pte. E. T. R. Whittle, R.A.M.C., for their invaluable assistance.

#### NOTE.

##### ON TREATMENT OF CASES RESISTANT TO SULPHANILAMIDE.

It has been observed, very recently, that resistant cases, showing gonococci in their urethral smear on and after the third day of sulphanilamide treatment without lavage, can be rendered dry in a few days by potassium permanganate irrigations. In such cases the course of the drug is extended to a fortnight while lavage is carried out concurrently twice daily. The ultimate results of this procedure are not yet known; there are indications, however, that they may prove satisfactory.

## Editorial.

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### THE STATE OF THE PUBLIC HEALTH.

THE Annual Report of the Chief Medical Officer of the Ministry of Health for the year 1936 appears in the Coronation year of King George VI. One hundred years have elapsed since the Coronation of Queen Victoria, and Sir Arthur MacNalty reviews the remarkable progress that has been made in national health during this period. The reign of Queen Victoria witnessed the setting up of a Central Health Authority, first as a General Board of Health, then as a Department of the Privy Council, and finally as the Local Government Board.

Sir Arthur MacNalty points out that experts like Simon, Chadwick and Snow, though they furnished admirable reports, failed to obtain the co-operation of the public in the necessary reforms. They ignored the Englishman's preference for self-government. "The English people would prefer to take the chance of cholera rather than be bullied into health," said *The Times*. Great novelists, like Lord Beaconsfield in *Sybil*, Charles Kingsley in *Alton Locke*, Mrs. Gaskell in *Mary Barton*, and above all Charles Dickens in *Oliver Twist*, *Martin Chuzzlewit* and *Bleak House* awakened the public conscience.

Lord Beaconsfield's Government in 1875 passed the great Public Health Act, the *Magna Charta* of Public Health as it has been termed, which consolidated all the previous sanitary enactments in a great sanitary code.

From 1875 to 1900 the Local Government Board instituted a series of progressive reforms comprising general sanitary improvements, pure water supplies, pure food supply, provision of isolation hospitals, public vaccination, supervision of common lodging houses, etc.

During the reign of Edward VII the School Medical Service was introduced in 1907, and in 1908 the Children's Act was passed. King Edward's Hospital Fund, to which the people readily responded, is a permanent memorial to the King's personal interest in the public health and the relief of suffering.

In King George V's reign the National Insurance Act was passed, and out of this Act was born the Medical Research Council. This Act of 1911 contained provision for the prevention and treatment of tuberculosis among the insured workers.

In 1912 the provisions were extended to the whole community and the recommendations of Lord Astor's Departmental Committee led to the schemes for the prevention and treatment of tuberculosis applicable to the whole population being carried out by County and County Borough Councils.

Maternity and Child Welfare Services were established soon after the Tuberculosis Services, and the Maternity and Child Welfare Act of 1918 extended the powers of Local Authorities to make arrangements for safeguarding the health of expectant mothers and of children under five years of age. The State now supervises the health of the child from infancy up to the end of school life.

In 1913 a Royal Commission on Venereal Diseases was appointed and reported in 1916 and recommended each County and County Borough Council to set up a scheme for the treatment of venereal diseases.

The establishment of the Ministry of Health in 1919 created a central authority for the purpose of supervising the health of the people *as a whole*. The Ministry took over the the work of the Local Government Board, of the Board of Control, and certain medical duties of the Board of Education. Central co-operation is secured by consultations within the Ministry and with other Government Departments. Co-operation with the medical profession has been established for many years and from time to time conferences take place with representative bodies of the medical profession and public health authorities.

Sir Arthur MacNalty points out that in the General Practitioner services there are Regional Medical Officers who perform both clinical and administrative duties in assigned areas in different parts of the country. In these ways the Ministry is kept in close touch with the whole question of the work of general practitioners of medicine and surgery in relation to State medicine.

The co-operation of Medical Officers of Health with the civil medical profession has assumed great importance of late years in view of the outbreaks of typhoid fever in Yorkshire, in the Bournemouth area and in Croydon. Letters on this subject have recently appeared in *The Times* advocating still closer co-operation.

More than one hundred Acts concerned with health and sanitation have been passed during the last quarter of a century. One of the most important of these is the Public Health Act of 1929, which transfers the functions of each Poor Law Authority to the County Council or County Borough Council. The Boards of Guardians set up in 1934 gave place to the Public Assistance Committees of the Councils.

Sir Arthur MacNalty writes that the last twenty-six years of medicine may be divided into three periods: 1910-14, 1914-18, and 1918-37. During the first period the outlook was broad and clinical and its findings were supported by pathology and by bacteriological aids to diagnosis. The second period covers the tragedy of the War years when notable advances in medicine and surgery were made. From 1918 to 1937 was a period of reconstruction, during which British medicine maintained a high standard. I saw the development of knowledge concerning deficiency diseases and vitamins; the treatment of pernicious anæmia by liver therapy; the discovery of insulin; fresh discoveries in neurology, psychiatry and heart disease; the rise of orthopædic surgery; deep x-ray therapy, etc.



In 1910 the social services of the State involved an expenditure of £55,000,000, but in 1934 this had risen to the enormous figure of £427,000,000.

Sir Arthur MacNalty naturally feels great pride in the hundred years' review of preventive medicine. He writes: "So much has been gained, so much health, vitality and happiness have replaced destitution, ignorance and despair."

The estimated mid-year population of England and Wales for 1936 was 40,839,000. The change in the age constitution—towards a rise in the average age of the population—mentioned in previous Reports has continued.

The birth-rate was 14·8, compared with 14·7 in 1935. The crude death-rate was 12·1 per 1,000 persons compared with 11·7 in 1935, and 11·8 in 1934. The standardized death-rate was 9·2 per 1,000 persons. The first quarter of the year accounted for the whole of the rise in the annual death-rate.

The five principal certified causes of death at all ages were: Diseases of the heart and circulatory system; cancer, malignant disease; bronchitis, pneumonia and other respiratory diseases; diseases of the nervous system; all forms of tuberculosis. If the causes are set out in the order of magnitude for the age period 15-65, man's working life, then all forms of tuberculosis take the third place.

The infant mortality was 5·9 per 1,000 births as against 5·7 in 1935. The increase was due entirely to the first quarter of the year. As was noted in the Annual Report last year nothing is more remarkable than the decrease in infant mortality in the last thirty years and no spectacular improvement can now be anticipated. So far as rates of mortality can be trusted it is certain that this fall in infant mortality has not been associated with any deterioration of mortality rates at later ages. There is no evidence that the improvement in environmental conditions has led to the saving of lives of the "unfit" with the result of decreasing the *average* stamina of survivors, and so lowering the resistance of the population at later ages.

In the Section devoted to general epidemiology attention is drawn to three extensive outbreaks of infections conveyed by milk.

In the Bournemouth, Poole and Christchurch outbreak the origin was a carrier of *B. typhosus* who unwittingly contaminated a stream which was responsible for the outbreak, but how the milk supply became infected by the water in the stream was not determined.

In October, 1937, at Wilton 100 persons had enteritis a few hours after consuming a certain milk. The source of infection was the cow herself.

In the third outbreak, at Doncaster, 200 to 300 persons contracted scarlet fever or infectious sore throat and two died. In this outbreak

both human being and animal played a part, the former infecting the milk and then a cow, which thereafter became the responsible agent.

Five cases of acute nervous disease following vaccination were reported in 1936. All five cases were primary vaccinations, and four were children of school age. The Ministry have repeatedly deprecated vaccination of children at this age, unless they have been directly exposed to smallpox infection. In a further report of the Committee on Vaccination it is stated that in the event of acute nervous symptoms supervening useful results have followed the intravenous injection in ten cubic centimetre doses of the serum of a recently vaccinated person.

In the Annual Report for 1935 references were made to the hospital treatment of scarlet fever and the difficulty of dealing with cross-infections in the multiple bed wards of isolation hospitals. It has been shown that a patient from scarlet fever due to one type may contract an infection with another type of streptococcus present in the ward.

Okell and Elliot have recently called attention to the danger of cross-infection with hæmolytic streptococci in otorhinological wards in which patients with septic conditions such as acute otitis, acute mastoiditis, are admitted alongside relatively "clean" patients. As a means of prevention they recommend a modified system of barrier nursing carried out by a specially trained staff.

In the Annual Report for 1934 it was pointed out that fluctuations in the number of cases of diphtheria, both seasonal and other, are in the natural order of events and there are no indications of a decline but rather the reverse. Similar observations have been made on the Continent of Europe. In the past five years the incidence in Germany has increased from 9·9 for 10,000 inhabitants to 22·8; the corresponding figures for this country are 14·2 and 20·8.

The Departmental Committee of the London County Council are definitely in favour of giving the entire amount of anti-toxin in one dose in order to ensure an earlier and higher concentration in the blood; they point out that subsequent doses, even of larger quantities, cannot adequately compensate for the deficiency of the first.

The incidence of encephalitis has continued to fall since 1924, but the ratio of deaths notified has increased; in 1935 they were double the notifications. The prolonged and ultimately lethal effect of the virus is thus emphasized. Dr. Cooper, from an examination of 174 cases, found it impossible to state for a period of eight years whether a patient was stationary or would not develop parkinsonia. No limit can be set as to when symptoms will not appear, and recovery is not to be expected.

The notifications of cerebrospinal fever were somewhat higher in 1936

than in 1935, but there is no reason to assume that a new high incidence is likely to occur soon.

In the last Annual Report it was stated that in the inter-epidemic years the proportion of cases of meningococcal meningitis caused by Group II strains is usually high and a Group II therapeutic serum has been made available. During the year some observations have been made on the action of p-aminobenzene sulphonamide on meningococcal infections. The results are promising, but further research is considered to be necessary.

Maternity and child welfare services are now accepted as an essential part of the public health work of local authorities. They are now undergoing steady development. The main enactments by which these services are now governed outside London are incorporated in the Public Health Act, 1936, which came into operation on October 1, 1937. The maternal mortality for 1936 per 1,000 total births was 3·65. This is a reduced rate as compared with the maternal mortality ratio of 3·94 for 1935 and 4·41 for 1934.

In April, 1937, the Ministry of Health published the report of a special investigation into maternal mortality in England, which has been made by the medical officers of the Ministry with the assistance of Sir Comyns Berkeley.

It became evident early in the inquiry that an important single factor in maternal mortality is the standard of midwifery practice. The Minister then decided not to wait the completion of the report but to introduce at once the Midwives Act of 1936, which lays the foundation of a national service of trained midwives throughout the country.

Special emphasis was laid in the Report on the importance of combined effort and close co-operation between health visitors, general practitioners, medical officers of clinics, medical staffs of hospitals and consultant obstetricians. Without this team work, which the local authority is in the best position to secure, the fullest value cannot be obtained from the services provided. An essential contribution to the team work is the mother herself, and the report showed the importance not only of the provision of ante-natal and post-natal supervision, but of further efforts to persuade women to take advantage of the facilities provided. The Minister has accordingly urged local authorities to provide general educational teaching in this matter.

At the end of 1936 maternity accommodation in England was provided or subsidized by local authorities in 587 institutions, with a total of 8,289 beds.

There were 28,268 deaths from tuberculosis in England and Wales in 1936, as compared with 29,201 in 1935. The figures for both respiratory and non-respiratory tuberculosis are the lowest ever recorded. Mortality

attributed to respiratory tuberculosis has declined to the greatest extent in childhood, and is now less than half what it was ten years ago.

Among young adults of both sexes there has been marked decline in mortality since 1931.

During the year 1936, 55,128 new cases of tuberculosis were added to the notification registers of England, as compared with 55,418 in 1935. In view of the reduction of mortality during 1936, a considerably greater decline might have been expected. But 2,585 of these cases did not come to the notice of Medical Officers of Health until after the death of the patients; of these 1,617 were cases of pulmonary tuberculosis.

Greater use is being made of the Dispensary Service; the prime object of this is to enable patients to come under treatment while the disease is in a stage in which recovery is usually possible.

In some areas special stress is laid upon the detection of tubercle bacilli in the sputum. In cases where the sputum is repeatedly negative, and specially in the case of the children, Dr. Dixon, Chief Tuberculosis Officer of Birmingham, recommends examination of the faeces for acid- and alcohol-fast bacilli, a procedure advised by Dr. Inman, of the Brompton Hospital, thirty years ago. Out of 2,276 examinations, 3·4 per cent showed acid- and alcohol-fast bacilli. In the case of children washings from the stomach should be centrifugalized and the deposit examined for acid- and alcohol-fast bacilli; and whether found or not, some of the deposit should be injected into a guinea-pig. In 500 children of all ages up to 10 years, positive results were obtained in 7·6 per cent.

The number of new cases found by Tuberculosis Officers to be suffering from tuberculosis of all forms declines from year to year, but each year a greater proportion of contacts with these new cases is examined. It is particularly satisfactory to note the increasing importance which is being given to the examination of adult contacts, for it is among these that undiscovered cases of pulmonary tuberculosis are most likely to occur. The importance of this work is emphasized by the Joint Tuberculosis Council who issued a Memorandum on the examination of contacts during the year.

In 1936 there were 24,000 beds in Public Health Hospitals and Approved Sanatoria occupied by patients dealt with under the Tuberculosis Service. Unfortunately, many of the patients admitted have little or no prospect of recovery. In view of the improved methods of treatment good results can be expected when the patient is admitted in a sufficiently early stage of the disease.

During recent years several Authorities have provided accommodation for observation cases which is independent of that provided for diagnosed tuberculous patients. Birmingham and Middlesex have provided in their sanatoria separate pavilions devoted to these cases. In other instances cubicles have been provided in such a manner as to secure complete separation of observation from tuberculous patients.

The experience of the year 1936 has continued to support the view that Medical Officers of Health are increasingly zealous in their efforts to improve the measures of the County Councils and County Borough Councils for preventing the spread of venereal disease. There are 186 treatment centres in England and Wales, and it is considered that the annual returns of these centres afford reliable information of the incidence of syphilis in this country. It is noted that of 295,750 doses of approved arsenobenzene compounds 88·3 per cent were supplied to venereal diseases treatment centres, 6·8 per cent to other institutions for the treatment of venereal diseases, and 4·8 per cent to private practitioners. The cases treated in other institutions were chiefly of old standing. Cases dealt with in all institutions, treatment centres, and by private practitioners in 1936 did not exceed 7,000, representing 1·7 per 10,000 of the population.

The measures taken under the Venereal Diseases Regulations are lowering the incidence of fresh infections with syphilis. Too much syphilis in women and girls still goes undetected. To remedy this defect routine tests of the blood of pregnant women attending the ante-natal centres have been suggested. Besides this an extension of the practice obtaining in a number of clinics of testing the blood of every patient, whether syphilis is suspected or not, may reveal latent syphilis in women.

In 1936 there were 28,137 male cases and 7,715 female cases of gonorrhœa, representing a rate of 13·6 males and a rate of 3·1 females per 10,000 of male and female populations respectively. The combined rate of 8·1 is much lower than that in other countries, such as Sweden and Denmark, where campaigns against venereal disease have been pursued actively for many years.

In the case of females there is strong evidence that the centres deal with only a fraction of these cases occurring in the community.

The serum tests for syphilis increased by 22,438, the increase being made up of 6,868 Wassermann and 15,570 flocculation tests. The flocculation tests were usually supplementary to the Wassermann and the figures indicate that now approximately 30 per cent of the serum specimens are tested by two or more methods. The practice of testing sera for syphilis by at least two methods has been recommended by the Health Organization of the League of Nations. It is still not so general as could be desired.

In 1936 there was a further increase in mortality from cancer. In both sexes the certified deaths were 66,354 as against 64,507 for last year. The crude mortality rate for 1901-05 was 867 per 1,000,000 living; in 1936 it was 1,625. The recorded increases of mortality do not necessarily connote an increase in the general causational factors. The rising rates do increase the seriousness of the administrative problem of provision of adequate means for diagnosis and treatment.

While the rates for a number of organs, e.g. lip, tongue, jaw, uterus

and skin have fallen considerably between the earliest and the latest periods, they have remained practically stationary with a tendency to fall during the last five years. These are all "accessible" parts in which increased accuracy of diagnosis has probably played a small part. The falls are probably due to diminished incidence and the effect of treatment. Another group consisting of the stomach, liver, pancreas and rectum shows a marked rise, the increased rates being due to greater frequency or better diagnosis, or both. Treatment can have little effect on these rates. The increase is generally supposed to be due to better diagnosis.

Investigations into the causation of cancer continue with great vigour and are chiefly concerned with the action of carcinogenic substances and the changes taking place in the cells which induce malignancy and with those initiated by the discovery that a virus disease in fowls can be transmitted to a mammal.

In a later editorial we hope to deal with the remaining sections of Sir Arthur MacNalty's interesting Report.

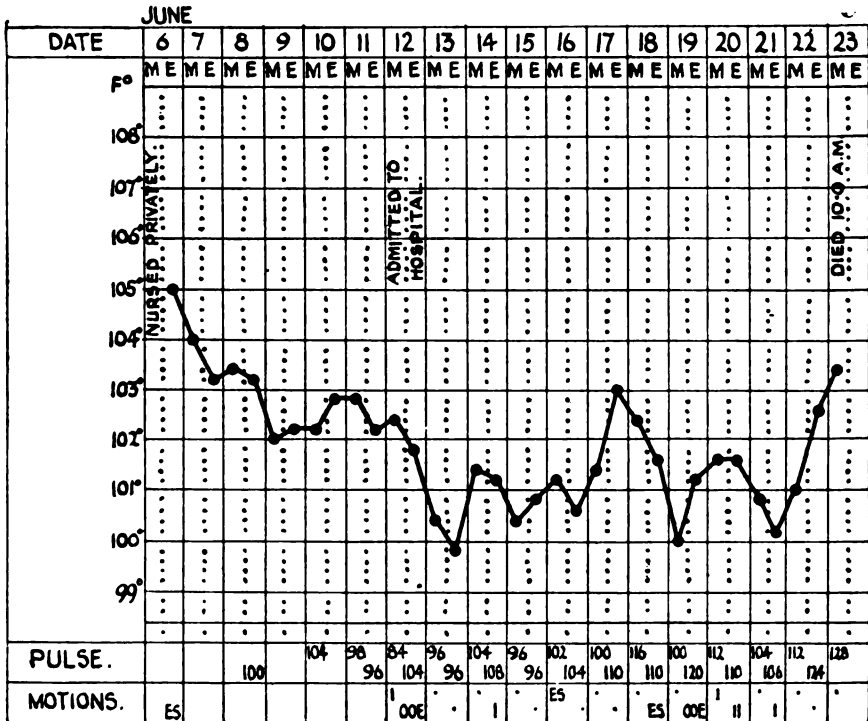


## Clinical and other Notes.

### BACTERIUM AERTRYCKE—THE CAUSAL ORGANISM IN A CASE OF ENTERIC FEVER.

BY CAPTAIN N. I. MCLEOD.  
*Royal Army Medical Corps.*

*Bacterium aertrycke* is a natural pathogen of rodents, causing in mice the characteristic "mouse typhoid"; less commonly, an analogous infection affects rats, guinea-pigs and rabbits. In man, its pathogenicity is limited almost entirely to the production of an acute gastro-enteritis. The



following case, an infection of the enteric type, is one from which *Bact. aertrycke* was isolated from the blood, urine and faeces.

Mr. E. L. H., a European, aged 69, a retired Inspector of Government Schools. He had never had a previous illness of a serious nature. He had not been inoculated against the enteric group of fevers. Ten days before admission to hospital he complained of lassitude, anorexia, headache,

and constipation. Three days later his temperature rose to 104° F. His attending physician diagnosed and treated him as an enteric case. He was eventually admitted to the British Military Hospital, Bareilly, as the nursing facilities at his home were inadequate.

On admission the patient presented a typical picture of an advanced fever of the enteric type, with an unfavourable prognosis. Temperature 102·2° F., pulse 86, respiration 36. The lips and mouth were dry; the dorsal surface of the tongue was covered with a dirty white fur, and its edges reddened. There was hypostatic congestion at the bases of both lungs, with bronchopneumonic consolidation. The abdomen was distended, the spleen tender and palpable. The heart was enlarged, and the sounds were feeble. The pulse was of poor volume, easily compressible. The skin was dry; no eruption was visible. Routine examination also revealed a prostatic enlargement.

The patient's condition deteriorated gradually. Delirium and incontinence followed marked restlessness and carphologia. The heart became more enfeebled; the pulmonary congestion increased. The patient died on his eleventh day in hospital, twenty-one days after the onset of symptoms. Permission for an autopsy was refused.

#### LABORATORY FINDINGS.

(1) Total white cell count showed a leucopenia, 4,200 per cubic millimetre (eleventh day of disease).

(2) Urine examinations revealed an albuminuria and a few pus cells.

(3) Blood cultures were taken on the eleventh and thirteenth days of disease. Both specimens yielded an organism in pure culture, indistinguishable from *Bact. paratyphosum* B, morphologically and biochemically. Serologically, the organism was agglutinated by *Bact. paratyphosum* B serum (Dreyer 1:1000); absorption tests were not carried out in the Brigade Laboratory, Bareilly, but the sub-culture submitted to the Enteric Laboratory, Kasauli, was identified as *Bact. aertrycke*, the type phase of the organism reacting to full titre with serum of *Bact. aertrycke*, but was not agglutinated by *Bact. paratyphosum* B serum. Similarly, the "O" antigen was found to be identical with that of *Bact. aertrycke*.

(4) Widal and Weil-Felix reactions, as tabulated below, showed an appreciable rise in titre (Dreyer's technique) with *Bact. paratyphosum* B "H"; while with *Bact. typhosum* "O," *Bact. paratyphosum* B "O," and *Bacillus proteus* OXK, very slight rises were apparent by Felix's technique. On account of the patient's condition, further agglutination tests were abandoned.

(5) Fæces and Urine Culture. From 19 examinations of fæces and urine, 3 specimens of fæces and 2 of urine were positive; the sample of fæces plated on the seventeenth day of disease yielded the organism in almost a pure culture.



Day of disease :	Dreyer's technique		Felix's technique	
	11th	13th	11th	13th
<i>Bacterium typhosum</i> "H" .. ..	25	50	—	—
<i>Bacterium paratyphosum</i> A "H" ..	25	50	—	—
<i>Bacterium paratyphosum</i> B "H" ..	125	5000	—	—
<i>Bacterium typhosum</i> "O" .. ..	0	0	50	125
<i>Bacterium paratyphosum</i> A "O" ..	0	0	50	50
<i>Bacterium paratyphosum</i> B "O" ..	0	0	125	250
<i>Bacillus proteus</i> OX2 .. ..	0	25	125	125
<i>Bacillus proteus</i> OX19 .. ..	0	0	50	50
<i>Bacillus proteus</i> OXK .. ..	0	0	125	250

## SUMMARY.

From a fatal case of fever of the enteric type, in an elderly civilian, unprotected by T.A.B. vaccine, *Bact. aertrycke* was isolated from the blood-stream, the fæces and the urine. This organism, contrary to its normal mode of human infection, was undoubtedly responsible for the clinical manifestations of the case.

I am indebted to Lieutenant-Colonel E. C. Beddows, M.C., Royal Army Medical Corps, Officer Commanding the British Military Hospital, Bareilly, for permission to forward these notes for publication, and to Lieutenant-Colonel R. F. Bridges, Royal Army Medical Corps, Officer-in-charge of the Enteric Laboratory, Kasauli, for the serological analysis of the organism isolated.

## REFERENCE.

TOPLEY AND WILSON. "The Principles of Bacteriology and Immunology," 1929, vol. i, p. 444

A WATER-BORNE OUTBREAK OF ONE CASE OF  
TYPHOID FEVER.

BY COLONEL H. W. GRATTAN, C.B.E., D.S.O.

*Late Medical Officer of Health, Biggleswade Urban and Rural Districts, Welwyn Urban and Welwyn and Hatfield Rural Districts.*

ON March 25, 1935, a case of typhoid fever was reported to me by telephone, and the doctor asked me if I would meet him at the house where the patient was employed.

The girl worked with two other persons in the kitchen of a large country house. She had been admitted some days previously to the observation ward of the local hospital and a report had been received that morning that the Widal test was positive to *B. typhosus* in a high dilution.

The patient had visited her home in London some days previous to the onset of her illness. It was ascertained, however, that no cases of typhoid fever had been notified in that London borough for some months.

The three members of the kitchen staff at the country house, including the patient, all suffered from gastric disturbance within forty-eight hours of their arrival and recovered quickly; about a fortnight later one of the three developed an attack of true typhoid fever.

Eleven other persons—residents and staff of the estate—had recently suffered from attacks of gastric disturbance of varying degrees of severity. In one case the illness, which was severe, was attributed to eating mushrooms.

Bacteriological tests were carried out with a view to determine the nature of the gastric cases, but no evidence was forthcoming that any were cases of typhoid or paratyphoid fever.

The estate was supplied with water from two different sources—an artesian well and a shallow well known as the “water wheel” well, which was situated about six feet from the banks of a stream which received the purified effluent from the sewage disposal works of a town some miles distant with a population of 70,000. The shallow well was about six feet deep and was fed from a spring. The water was raised by a water wheel to one of a pair of reservoirs situated on high ground about one furlong from the house and gravitated thence to: The interior of the cowsheds; one of the two dairies where milk was set for butter-making; a reserve tank under the roof of the house which supplied the baths, lavatories and hot-water system, including a hot-water tap over the kitchen sink; the garden.

Samples of water were submitted for bacteriological examination and report from the “water wheel” well and the reservoir supplied from that well. Both samples were found to be contaminated with sewage or manurial matter (*B. coli* being present in 1 c.c. and *B. welchii* in 100 c.c.).

A third sample of water was examined from the artesian well via the cold-water tap in the kitchen, and the sample was found to be pure and free from contamination.

The following action was taken the day that the case was notified:—

The supply of water from the “water wheel” well and corresponding reservoir was cut off.

The dairy which was supplied with water from the above well was closed.

A recommendation was made that all milk and water for drinking and cooking and all milk should be boiled.

Steps taken subsequently included the following: The reservoir which was fed from the shallow well was emptied and cleansed by means of a chlorine spray—the work being carried out by a firm of engineers who specialize in this work. The reserve tank under the roof of the house was similarly treated, and the system of drainage was examined under arrangements made by the Surveyor and Sanitary Inspector.

The outbreak of illness came to an abrupt termination after the contaminated water supply had been cut off.

The water supplies to the estate had been subject to periodical chemical

examination, and there was evidence that the quality of the water from the shallow well had deteriorated. The owner of the estate, however, was unaware of this fact, as he had only recently inherited the property.

I learnt that visitors and new comers were subject to digestive disturbances when they first arrived. The water supply, however, was not suspected as being the source of the trouble. The property has now been connected up to the Public Water Mains.

I have to thank Dr. H. Hyslop Thomson, Medical Officer of Health for the County of Hertfordshire, for permission to send this note for publication.

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## Travel.

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### TYPHOON.

BY LIEUTENANT-COLONEL S. SMITH,  
*Royal Army Medical Corps.*

HONG KONG has had her full share of excitement during 1937, and although almost a haven of rest compared with our noisy and war-stricken neighbour Shanghai, has not been spared her anxious moments.

First we were visited by a major epidemic of cholera, which, although up to the present confined entirely to Chinese, mostly of the destitute class, has given the Health Department furiously to think, and has in little more than a month resulted in over fifteen hundred cases with more than half that number dead.

Then we were required, at short notice, to take in large numbers of refugees, of all nationalities and of every grade of society, from stricken Shanghai; the finding of accommodation for these people, arriving at the rate of often more than a thousand a day, by every liner that reached us from Shanghai and the North China ports, further taxed the resources of our administrators.

Hardly had these unfortunates, many of them possessing little more than the clothes they stood up in, been provided for, than we were almost literally "flattened out" by the fiercest typhoon in Hong Kong's long history of similar happenings.

Typhoons are by no means frequent occurrences even in Hong Kong, —one every three or four years being our normal ration—and as we had experienced a severe example of Nature in her most flamboyant mood last August, we hoped, even after the warning signal had been hoisted, that this one would pass us by with nothing more serious than a "blow" or a downpour of rain. But such was not to be.

Luckily, thanks to an efficient wireless and broadcasting system and our effective Meteorological Department, ample warning was given of the approach of the typhoon, and No. 5 signal, heralding its near proximity,

was hoisted many hours before we received its first buffets. No. 1 signal was actually hoisted at 12.35 a.m. on Wednesday, September 1, more than twenty-four hours before the typhoon struck us, and No. 5 signal was hoisted at 3.20 p.m. on Wednesday afternoon.

As a result of this timely but very necessary warning, most of the small craft, junks, sampans, small coasting steamers, motor launches, etc., were able to make for one or other of the numerous typhoon shelters in and around Hong Kong; consequently the loss of life, though serious enough, was far less than it might have been. This is true, of course, only for Hong Kong and its very near vicinity, and the numerous trading and fishing junks caught in the open sea must have suffered terribly, and to an extent which will probably never be fully known.

When a typhoon or strong gale is approaching the Colony, which it usually does from the south, from the general direction of the Philippine Islands, a series of typhoon signals or "symbols" is hoisted from various vantage points in and around Hong Kong. The most conspicuous is that hoisted on the mainmast of H.M.S. "Tamar," a large hulk lying in the naval basin, which flies the broad pennant of the Commodore.

These signals, ten in number, of which only six are used in Hong Kong, are painted black, and the shapes are easily distinguishable. Thus, No. 1 is a large "T," which denotes a depression or typhoon which may possibly affect the Colony. Familiarity with No. 1 signal, which is normally hoisted on many occasions during the typhoon season from June to October, breeds such contempt amongst the older inhabitants that but little immediate notice of it is taken, although certain routine precautionary measures are taken by the Naval and Military authorities.

No 5 signal, the next to be hoisted in Hong Kong, is a large black cone "▲." At this we all sit up and take notice, since it denotes that a typhoon or strong gale is in the vicinity and may or may not strike the Colony. When this signal is hoisted all small craft scuttle for shelter; naval ships leave the naval dockyards and wharfs and move to strongly moored Admiralty buoys in the middle of the harbour; whilst two powerful Admiralty tugs lie with full steam up in the naval dockyard ready to give a hand when and where needed. All vessels in the harbour capable of so doing get full steam up and look to their moorings preparatory to the "blow."

A medical officer, specially detailed for the duty week by week, on No. 5 signal being hoisted, immediately sets out for Stonecutters Island, a small island used as a naval arsenal lying in the centre of the harbour, and occupied by a small garrison comprising some few officers and their wives, a battery of gunners with their families and a few naval ratings. The medical officer detailed must be prepared to remain isolated on the island, often for several days, until such time as the typhoon has passed or the "all clear" is hoisted.

As far as the military hospital is concerned, all jalousies are securely

fastened; typhoon bars screwed down and doors bolted and barred. The hospital carries emergency typhoon rations in the event of communications breaking down. The orderly medical officer is not allowed to leave the hospital unless for an urgent call.

The four symbols 5, 6, 7, 8 are of equal value as regards the proximity of the typhoon and merely indicate the general direction from which it may be expected.

No. 9 signal, which denotes the near proximity of the typhoon is often omitted, and the next to be hoisted—as in this case—may well be No. 10 signal, a cross +, which denotes that a gale of typhoon force is about to strike the Colony. At this signal all voluntary movement in the harbour, including the trans-harbour ferry service, ceases, and Hong Kong remains cut off from her large suburb of Kowloon until after the passage of the typhoon. The hoisting of No. 10 signal is immediately followed by the firing of three explosive bombs or maroons at intervals of ten seconds, and then the fun commences.

At night various combinations of coloured lights replace the day time signals; thus, three white lights, one under the other, indicate No. 1 signal; a white and two greens, No. 5 signal; and red-green-red, No. 10 signal.

The typhoon I am about to describe was first reported in our morning newspapers of August 29 as having appeared in the Pacific and threatening Luzon at the northern extremity of the Philippines, a district where many typhoons develop.

During the next three days the typhoon pursued its leisurely way north of Luzon, passed in the vicinity of the Pratas Shoals (since occupied by the Japanese for their South China operations) and hit the Colony a tremendous "bump" at about 1.58 in the early morning of Thursday, September 2, 1937.

Long ere this all the small craft in and near the harbour had scuttled to the nearest shelter giving the harbour an unusually "static" appearance in place of the usual scene of bustle and hurry, and the larger steamers—swollen to over a hundred by recent events in North China—were safely (a very relative term) at their various moorings and anchorages; those in commission with a "full head" of steam, ready to ride out the gale.

My flat in May Road has a magnificent view overlooking the harbour of Hong Kong and it was a fine if somewhat awesome sight to see half a dozen large liners, including two P. & O. vessels, the German "Gneisenau" and the Italian "Conte Verde," leave their positions alongside the Kowloon Wharf about 6 p.m. for the various anchorages where they were to ride out the typhoon, if they could. With their stately mien and proud carriage they reminded me irresistibly of the proud "Aristos" of the French Revolution making their last fateful journey to greet *mère* "Guillotine." Unlike the aristocrats of that epoch, however, all returned safe and sound, with the exception of the "Conte Verde." The drifting B.I. liner "Talamba" fell foul of the latter and, snapping her anchor chain, caused

her to drift, fighting every inch of the way with full steam up, on to a sandy shoal in Sai Wan Bay, just outside the harbour limits. There she still lies, some weeks after the "blow" in near proximity to the new N.Y.K. liner "Asama Maru," which is also aground on a neighbouring shoal.

The "Talamba" finally came to rest, if rest it can be called, on the northern shore of Lymun Pass under the forbidding rocks of Devil's Peak, and lies in a most unenviable position.

The future of these three large liners, in common with a whole host of smaller craft (twenty steamers in all ran aground in and around Hong Kong harbour), appears to depend largely on the vagaries of the weather during the next few weeks. Up to the present, a fortnight after the typhoon, the weather has been unusually kind, and salvage operations have been able to proceed apace, many of the smaller vessels having been refloated.

Long before the typhoon broke over Hong Kong my wife and I had, with the help of our servants, done what we could to turn our small flat into an impregnable fortress against the mighty gusts of wind and torrential rain which were shortly to assail us. All typhoon bars were fixed in position and securely screwed down; bolts fastened, and electric torches placed near at hand in the event (which actually happened, and is almost bound to happen in such an event) of the electric light failing. Having done what we could we returned to bed, but not to sleep, for even by midnight a howling gale was raging, which appeared to increase every moment as the gusts grew fiercer and more insistent. By 1 a.m. the gale had increased to almost typhoon force, and we were both kept busy for the next several hours mopping up the streams of water which cascaded through the more exposed window frames, tightly closed and moderately close fitting though they were; gallons of water also poured on to the floor via the chimneys, this adding somewhat to the general discomfort as the water was sooty in the extreme. Luckily, at no time did we actually feel ourselves in danger, as the main fabric of our sturdy building stood up well to the onslaught, and no real damage was done, outside or in.

We thus escaped the harrowing experiences of many of our friends, some of whom spent literally a night of terror, expecting at any moment what remained of their houses to come crashing about their ears.

During the height of the storm, whilst resting a moment from our labours, we saw through the blinding rain an ominous glow in the direction of the City of Victoria. This we learnt later was due to a disastrous fire at West Point which cost many lives.

By breakfast time we were able to take stock of our position, and found that as far as our tiny flat was concerned little material damage had been done. The gale was now blowing itself out, and No. 8 signal which had been hoisted in place of No. 10 during the early morning was shortly hauled down, denoting that yet another typhoon had "been and gone and done it."

From our verandah we could see the harbour tugs scurrying in every

direction, as if "sniffing" at the state of salvage operations that lay ahead of them.

I shall not quickly forget my mile walk to the hospital that morning. The roadways and paths were literally choked with every conceivable kind of litter, including large uprooted trees, massive torn-off branches, huge blocks of masonry, broken tiles, portions of chimneys, etc.; the latter hurled often from houses several hundred yards away. Telephone and



FIG. 1. The "An Lee," thrown up on the Praya, West Point, Hong Kong.

telegraph poles and wires were down all over the place and helped to impede progress; assuredly a true scene of desolation.

On arrival at the hospital I found that considerable damage had been done there, despite the fact that every precaution had been taken. The roof of one large ward had been partially blown away during the height of the typhoon, necessitating the rapid removal of all patients from this ward and the ward below to safer and dryer quarters. This was a somewhat serious contretemps as we were in the process of expanding to our limit to accommodate the casualties that were shortly to arrive from Shanghai.

During the course of the morning we appreciated how lucky we had been to be housed in an unusually solid building and how badly those houses suffered which were not in their *première jeunesse* or in a poor state of repair.

Looking down from our "eyrie" on the Peak we could see below us in all their nakedness many of the effects of the previous night's storm ; roofs wholly or partly denuded of their tiles ; caved in walls ; dismantled chimneys.



FIG. 2.—The Tug that attempted to succour the "An Lee."

In spite of all this damage—superficial and shortly to be repaired though much of it was—incredible though it may seem, I heard of no European killed or even seriously injured on the Island. Luckily the Shanghai refugees in their temporary quarters at Happy Valley race course, Central British School, etc., appeared to have suffered but little.

During the afternoon following the blow I made a tour of the Island and obtained first hand, evidence of the havoc wrought along the sea front. Most of the numerous wharfs, solid wooden structures with equally solid buildings erected on them, were in a state of collapse, and in most cases "reduced to produce." Many a fine vessel lay aground on one or other



of the numerous shoals bordering the harbour or piled up on the sea front. One of the latter, the "An Lee," had a most venturesome passage before she ended her career—we will hope only temporarily—stern first high up on the Praya, a most undignified and unladylike position! She broke loose from her moorings during the height of the typhoon and drifted helplessly down the harbour before the gale, colliding with the bows of H.M.S. "Suffolk," a 10,000 ton cruiser, as she passed. So closely did she hug the latter as she swung past her after the collision that twelve members of her crews were able to jump to safety on the cruiser's deck; one missed his footing and was swept away. The "Suffolk" herself had to put into dock some days later for repair following the damage done to her.

Near the "An Lee," close up along the Praya, lay a wrecked Taiko tug, sunk as she was rushing to succour the "An Lee." Her entire crew were only saved after a tremendous struggle by a rescue party working roped together, alpine fashion, from the Praya sea front.

In all, some twenty large or medium sized vessels were lying hard aground in the near vicinity of Hong Kong as the direct result of the typhoon: some, luckily, on a sandy bottom from which they will be refloated in due course if the weather is kind: others, unluckily, thrown up on the rocks to become total wrecks when the next gale visits our shores.

Amongst those driven ashore was the Dutch liner "Van Heutsz," carrying twelve hundred deck passengers, mostly Chinese, in addition to some sixty cabin passengers. Her mooring chain broke during the gale and she drifted helplessly and dangerously on to Green Island, at the entrance to Hong Kong Harbour. She was badly holed amidships, but luckily the whole of her passengers and crew were brought to safety without mishap. She and another large modern vessel, the "Gertrude Maersk" which lay aground close beside her and assisted in the rescue of her passengers, have since been refloated.

At the other end of the harbour, towards Lymun Pass and beyond, similar damage had been done to shipping. Two large freighters were lying high and dry near North Point. Mention has already been made of the large three funnelled steamer "Talmada" lying hard aground in Lymun Pass, and of the Japanese "Asama Maru" and the Italian "Conte Verde," both aground in Sai Wan Bay just outside the harbour limits. At the time of writing, more than a fortnight after the typhoon, none of these had yet been refloated, and they are said to be waiting for the next spring tides in October before having another attempt at salvage.

If one adds to this already not inconsiderable list the large tally—said to number nearly twelve hundred—of junks and sampans that have become total losses, with, in many cases, their whole crews, that number up to forty in the larger junks, drowned, one has some idea of the havoc wrought in Hong Kong and its vicinity by this 1937 typhoon.

In addition a disastrous fire, the glow of which could be seen from our verandah, completely gutted a crowded tenement block at West Point in

China Town, and added horror to what was already terrifying enough. Thirty Chinese lost their lives in this fire, including a wretched terror-stricken woman who, with her infant strapped to her back Chinese fashion, jumped from a fifth storey room to instant death.

And this is not the whole story. One Friday morning, a full day after the typhoon, news came trickling through to Hong Kong of a disaster affecting the two fishing villages of Taipo and Shatarkok, caused by a tidal



FIG. 3.—Street choked with litter after the great tidal wave, Taipo.

wave, said by some to have been thirty feet high, which roared up Tolo Harbour, on which these two villages lie, and engulfed them both, incidentally ruining many hundreds of acres of fine young paddy in the near vicinity.

We visited Taipo, lying fifteen miles from Hong-Hong deep in the leased new territories, a few days after the disaster and found an almost indescribable scene of desolation and ruin.

The solid stone causeway and bridge leading to the village had been badly damaged, large masses of masonry having been "bitten off" like chunks out of a biscuit. Heaps of rubble and broken bricks represented

what had been solid dwelling houses. The streets, from which the flood had now receded, were choked with every conceivable kind of litter as well as with the thousand and one articles, pathetic in their simplicity, that make up the household goods of these poor fisher folk, and which they had rescued from their ruined and flooded dwellings. Luckily the weather had been fine and sunny since the typhoon, and many of the "exhibits" appeared to have suffered little from the wetting.

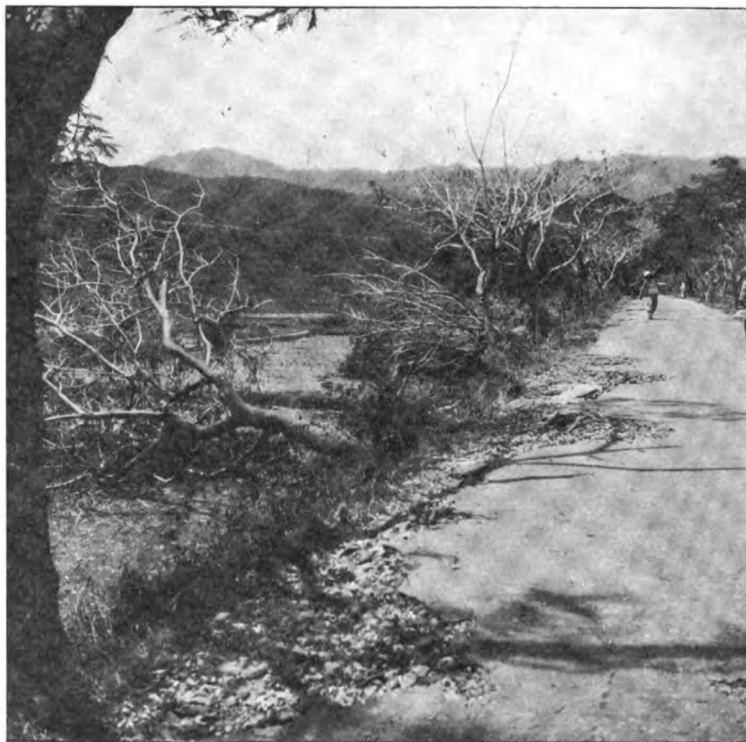


FIG. 4.—Roadway near Taipo after the tidal wave.

Upwards of two hundred are reported to have been drowned in the two villages, and there can scarcely be a villager still alive in either of them but mourns a near relative dead.

The stench caused by putrefying fish, decomposing vegetation and worse was almost unendurable, and we were only too pleased to leave the sorry spectacle after a few snapshots had been taken.

The Hong Kong-Canton railroad, which runs through an exposed section of the Shatin Valley bordering on Tolo Harbour, was breached for many miles and will take a considerable time to repair.

The typhoon was in many respects peculiarly selective in its destructive action, some districts escaping almost completely, others being badly

damaged. It was interesting to contrast the great damage done along great stretches of the Taipo road, especially where it ran along the sea board and received the full fury of the hurricane added to by the onslaught of the waves, with the very minor damage noticeable along the Castle Peak road which skirts the western border of the Peninsula of Kowloon for some thirty-six miles. The latter was open for motor traffic shortly after the "blow," while it was at least a week before the Taipo Road was negotiable with any degree of safety. Just beyond Taipo Village, towards the Colony's golf course of Fanling, there is a lofty railway embankment through which runs the road. On the Taipo side of the embankment all is desolation; the road is, or was for many days after the typhoon, quite impassable; uprooted trees and huge branches lay strewn about in all directions; houses were destroyed; and the paddy was "browned off" and destroyed over a wide area by the flooding sea water. On the Fanling side there was the usual smiling countryside; the paddy looked green and healthy; remarkably little damage had been done to buildings or trees; and the road was in perfect condition. This same selective action was noticeable in the Island of Hong Hong. Apart from the wholesale destruction of bathing matsheds, an easy prey to any strong gale of wind (and even in this respect less destructive than the typhoon of 1936), little damage was done to the southern portion of the Island, largely protected from the full fury of the gale by a backbone of lofty hills stretching across the Colony from east to west. The small fishing village of Aberdeen, which was literally choc-a-bloc with fishing junks and sampans, had also escaped comparatively lightly, and beyond a few dismasted junks and sampans there was no exterior evidence of any great damage.

Just as there is a reverse to every medal so every disaster has its lighter side. A rash young officer, well known in the Colony, who ventured out during the height of the typhoon, was forced to grasp a massive tree trunk in Nathan Road for a solid hour before he dared release his hold. He had not, so he said, clasped anything so unresponsive for many years!

A Yankee refugee from Shanghai when asked how he had fared during the typhoon replied that it was no novelty to him after the hurly-burly of Shanghai; he had, in fact, gone to sleep during the worst of the blow, but had omitted to shut his bedroom window; on wakening the next morning he was surprised to find deposited in his room a tree, two birds (feathered variety) and one lady's "nighty" (unoccupied), none of which he was positive were there when he went to bed the night before.

A total assessment of casualties is difficult in a country like China where the nomad junk and sampan dwellers suffer so heavily in a disaster of this description. One estimate, probably exaggerated, puts the total casualties at ten thousand and nearly twelve hundred junks and sampans wrecked in and around Hong Kong.

In conclusion, a few meteorological details concerning typhoons may be of interest.

In spite of the great velocity of the individual gusts of wind attained, unofficial estimates of gusts up to 175 m.p.h. being on record, the daily "march" of a typhoon is surprisingly small, the average speed being about 8 to 14 miles an hour, depending on the latitude. During the five typhoon months, June to October, about ten typhoons strike the China coast annually, but, of course, only a very small proportion of these affect the minute portion of coast line represented by Hong Kong, our ration being about one every three to four years.

The lowest barometric reading on record in Far Eastern waters was that recorded by the Dutch steamer "Saporea," in the centre of a typhoon, 26.18 inches on August 18, 1927.

During the present typhoon the official anemograph was unable to record gusts of over 125 m.p.h., but many gusts of much greater velocity than this are vouched for. An unofficial instrument belonging to the Hong Kong Electric Company is said to have recorded gusts up to 160 m.p.h. and between 2 a.m. to 3 a.m. the wind did not drop below 140 m.p.h.

A record low barometric reading (for Hong Kong) of 28.298 inches was recorded by the Observatory officials.

Over five inches of rain, not an excessive amount, fell during the few hours the typhoon lasted.

One curious effect of the typhoon was the bruising effect of the high wind velocity on certain varieties of trees, the branches and "wood" of these trees being but little harmed. Where these trees acted as avenues to some of the Colony's beautiful sylvian walks and pathways a most desolate and forlorn appearance was produced, much as though a blight or swarm of locusts had passed over the district. (This effect is well described by "Vinjar" of the *South China Morning Post* in his "Nature Jottings.")

The Hong Kong typhoon of 1937 will go down to history as an example of Nature in her most terrifying and ruthless mood, in sharp contrast to the even more terrifying and disastrous happenings at Shanghai, which have been entirely man-made affairs, and, one will hope, on that account, be preventable in the future.

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### Current Literature.

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DAVIES, J. A. V. **A Microflocculation Test for Syphilis.** *Venereal Dis. Information.* 1937, v. 18, 187-94. [12 refs.]

This author describes two modifications of the Hinton test—the micro and the capillary—which can be carried out on very small quantities of blood, whilst retaining the high degree of specificity and sensitivity of the original test.

(1) For the micro test 0.1 cubic centimetre serum after inactivation is mixed with 0.1 cubic centimetre Hinton indicator and another 0.1 cubic

centimetre with 0·5 cubic centimetre indicator. These are incubated for sixteen hours at 37° C. The tubes are then centrifuged for five minutes. A positive reaction is shown by clearing of the liquid with *definite* floccules in *either* tube; a negative by absence of clearing and absence of floccules in both tubes, whilst a doubtful one consists of questionable increase of the size of the granules originally present in the indicator or antigen.

For the capillary test the blood is collected in a capillary glass tube about 11·5 centimetres long and 1·25 to 1·5 millimetres inside diameter. 0·05 cubic centimetre serum is separated from the clot, transferred to another capillary tube and inactivated at 56° C. for half an hour. Serum and indicator are mixed in two separate capillary tubes in the proportions of 1 to 1 and 1 to 5 (judged by the length of the column of each), and the tubes are then sealed and incubated for sixteen hours. After these have been centrifuged for five minutes results are read under the low power of the microscope with the light cut down and the stage inclined at thirty degrees from the horizontal. Results are similar to those in the micro-reaction.

In an evaluation of sero-diagnostic tests for syphilis a series of 300 sera was examined by these two tests which gave identical results and were assessed as having a specificity of 100 per cent and sensitivity of 91·9 per cent.

In a further series of 372 tests 361 agreed with the clinical findings and 11 disagreed. Of these, 5 were apparently false positives, 5 doubtful and 1 false negative.

It is suggested that these tests are particularly suitable for blood donors, infants and children; moreover where time is important the tests can be carried out in just over one hour (inactivation twenty minutes, incubation thirty minutes, centrifuging ten minutes) with almost equally reliable results.

T. E. OSMOND.

*Reprinted from "Bulletin of Hygiene," Vol. 12, No. 11.*

DRINKER, P. **The Application of Air Conditioning in Normal Life.**

*J. Indust. Hyg. and Toxicol.* 1936, v. 18, 767-79, 8 figs.

This article summarizes the various standards of air purity and atmospheric physical measurements that give an index of comfort. Measurable quantities being temperature, moisture content, air movement, carbon dioxide concentration, odour intensity, dustiness, gas concentrations and degree of ionization. By means of modern air conditioning methods it is possible to obtain practically any combination of the above factors; all of them, except odours, being measurable with precision.

Comfort zones for summer and winter in respect of dry bulb temperature and humidity have been determined by the American Society of Heating and Ventilating Engineers of that country. A chart showing these comfort zones is reproduced. It shows that 98 per cent of the subjects tested considered an effective temperature of 71° F, to be most

comfortable in summer, while 97 per cent considered an effective temperature of 66° F. to be most comfortable in winter; the percentages voting for other temperatures as optima are also indicated. Clothing is considered to have an important influence on the degree of warmth required by persons in winter time. Higher temperatures are generally maintained in American buildings than in Great Britain, but Americans wear much lighter underclothing in winter time.

The measurement of radiant heat is not considered in connexion with the effective temperature scale, warming by radiation is very little used in North America, but curves due to Houghton and McDermott are reproduced showing the effects of cold walls on sensations of warmth.

Dust and pollens giving rise to allergic complaints may be removed from air by dry filtering, filters dealing with non-industrial dusts being comparatively easy to keep in order. Great improvements have been made during the last few years in the cleanliness of railroad cars in the United States by filtering the air. Ventilation air may be freed from bacteria by passing it through beams of ultra-violet radiation, but the need for such purification in everyday life has yet to be proved. Air conditioning is very effective in the control of body odours, but fails to deal with the odour of tobacco smoke. The old standards of 50 to 30 cubic feet of fresh air per minute may safely be reduced to 15 to 7 in the light of recent work. [Since publication Yaglou and Witheridge (*Heating, Piping and Air Conditioning*, 1937, July) have shown that body odours in a room disappear rapidly of their own accord, whilst the reverse is true of the odour of tobacco smoke.]

The artificial ionization of air has not so far been justified by experience. The author concludes that although the need for air conditioning as a necessity to health has not yet been proved, air conditioning more than justifies itself as a means to increase comfort and good living and as a necessity in certain industries. The protagonists of air conditioning should find sufficient in these reasons for advocating its adoption without calling upon hygienists for proofs that do not exist.

T. C. ANGUS.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 1.*

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## Reviews.

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PHYSICAL SIGNS IN CLINICAL SURGERY. By Hamilton Baily, F.R.C.S. Eng.  
Sixth Edition. Bristol: John Wright and Sons, Ltd. 1937. Pp. xii  
+ 284. Price 21s. net.

The Sixth Edition of this work does not differ very greatly from the Fifth Edition. The chapter on the neck has been divided into two: (1) the neck, excluding the thyroid gland, and (2) the thyroid gland. There are also some other re-arrangements and additions throughout the work, and

smaller print has been introduced for the less important matter. The book gives a comprehensive and clear account of all the most important and useful physical signs, and the excellence and number of the illustrations convey the intention of the writer in a most unforgettable manner. A considerable amount of other clinical information is also included. It is felt that this book would be of very great assistance to those going in for surgical examinations.

G. T. G.

THE SANITARY INSPECTOR'S HANDBOOK (Third Edition). By H. M. Clay, F.R.San.I., F.I.San.I., F.I.S.E. London: H. K. Lewis and Co., Ltd. 1937. Pp. xxii + 480, Price 16s. 6d.

The demand for this valuable book has been such as to allow of the publishing of the third edition after a lapse of a very short period since the previous edition saw the light of day.

During this period, however, there has been much additional legislation, and with the inclusion of this the book has been brought completely up to date.

The new legislation dealt with includes the Public Health Act 1936, the Public Health (London) Act 1936, the Housing Act 1936, the Factories Act 1937, the Public Health (Drainage of Trade Premises Act) 1937, the Hydrogen Cyanide (Fumigation) Act 1937, the Public Health (Imported Food) Regulations 1937, and the revised Model Byelaws relating to the buildings, now issued for the first time in a single series.

The subject matter of the book is adequately and clearly set out in as readable a manner as is possible, and it is of great assistance to the student to find the law in regard to each subject discussed in the chapter of the book dealing with that particular subject.

It is hard to find any points in regard to which even minor criticism is justifiable; but perhaps in view of the great importance of fly prevention more space might have been given to this subject, it seems illogical that almost three pages should have been devoted to the bed bug and only 17 lines to the fly.

The ammonia chlorine process for the purification of water receives, as in the previous edition, but scant notice and is referred to merely as a means of avoiding the objectionable tastes that occur at times when the chlorine process is used. It is suggested that in view of the increasing use of the combined process more details in regard to it should be given.

With reference to disinfection by current steam, no mention is made of the advantages of downward over upward displacement of steam and, as suggested by a reviewer of the previous edition, information in regard to this should be included.

The few small defects noted do not detract from the great value of the book to all students of public health and as a work of reference for use by all engaged in public health duties. It can be confidently recommended as an essential and extremely helpful volume to those interested in the subject.

A. E. R.



## Notices.

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### COMMANDANT, OFFICERS' CONVALESCENT HOME, OOTACAMUND.

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(iii) The officer will normally be required to vacate the appointment on attaining the age of 57 years. An extension for a specified period may, however, be granted.

(iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorized representative shall be the sole judge.

2. Applications should be addressed to the Director of Medical Services in India, Army Headquarters, Simla, and should reach him by March 31, 1938, at the latest. The selected officer will be required to join the appointment by April 15, 1938.

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### THE PARKES' MEMORIAL PRIZE, 1937.

MAJOR J. BIGGAM, M.C., R.A.M.C., has been awarded the Parkes' Memorial Prize for his very valuable investigations into the lighting of barracks and other military institutions, coupled with important work he has carried out in regard to the effect on vision of the wearing of the service respirator and the designing of a suitable spectacle frame for wearing with the respirator by men with impaired vision.

The Parkes' Memorial Prize is awarded annually to the officer who is considered, by the Committee, to have done most to promote the advancement of Naval or Military Hygiene by professional work of outstanding merit, and is open to medical officers of the Royal Navy, Army, and Indian Army, with the exception of the Professors and Assistant Professors of the Royal Naval Medical College, Greenwich, and of the Royal Army Medical College, London, during their term of office.

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**Original Communications.**

**BODY TEMPERATURE CONTROL AND PHYSIOLOGICAL  
REACTIONS DURING MUSCULAR WORK IN GAS PRO-  
TECTIVE CLOTHING.**

BY MAJOR G. P. CROWDEN, D.Sc., M.R.C.P.,

*Royal Army Medical Corps, T.A., University of London Officers' Training Corps.  
Reader in Industrial Physiology, University of London, London School of Hygiene and  
Tropical Medicine.*

(Continued from p. 156.)

**SECTION II.—FIELD TESTS.**

During the last week of July, 1937, a favourable opportunity for carrying out field tests on the effectiveness of wetted gas-protective garments arose at the camp of the University of London Officers' Training Corps at Swanage, Dorset.

Service respirators, steel helmets, and protective clothing, used for training purposes in the Medical Unit, U.L.O.T.C., were available for comparative tests and a number of officer cadet N.C.O.s volunteered to act as subjects and observers. This made it possible to carry out a series of tests on seven different subjects. With the assistance of J. Wright, who was attached to the unit as an instructor and who had recently attended a course in anti-gas at the Army school, the muscular work carried out by the subjects was arranged to simulate the preparation of a mixture of bleach and earth for the decontamination of ground. As several of the officer cadets were senior medical students from London hospitals, it was possible to use them as recorders of the pulse-rates and body temperatures of the subjects and this enabled the reactions of a large number of subjects to be continuously observed and noted. Naturally it was not possible to use electrical apparatus for recording the temperatures between the layers of clothing worn by the subjects, as had been the practice in the laboratory experiments, but mouth temperatures were taken and the condition of the subjects and degree of sweating were accurately noted. Field tests were carried out in chalk quarries near the camp on three days and, as will be evident

## 218      *Physiological Reactions during Muscular Work*

from the detailed records of these tests given below, the findings of the previous laboratory experiments were completely confirmed.

### *1st Field Test : Preliminary Trial of Protective Clothing.*

*Date:* Monday, July 26, 1937. *Time* 12 noon to 1 p.m. *Place:* Road-side quarry near Swanage. *Weather conditions:* Dull windy day. Dry bulb temperature 65° F. ; wet bulb 57° F.

*Routine.*—Three officer cadet N.C.O.s of the Medical Unit, University of London O.T.C., were used as subjects A, B and C. After being clothed in the protective garments detailed below, on a given signal the subjects commenced shovelling chalk into heaps with General Service shovels, this work being equivalent to mixing bleach and earth for decontamination of ground. Pulse-rates were taken before and after work and the condition of the subjects noted by observers.

#### *Details of trial :—*

	<i>Subject A.</i>	<i>Subject B.</i>	<i>Subject C.</i>
<b>Name and Age</b>	O/Cdt. Cpl. D. M. Cushing, 29 years.	O/Cdt. Cpl. J. B. Perkins, 25 yrs.	O/Cdt. Cpl. J. H. S. Scarlett, 20 yrs.
<b>Clothing : ordinary.</b>	Shirt, shorts, socks, boots and puttees.	Same as A.	Same as A.
<b>Clothing : protective.</b>	<i>Fabric covered rubber jacket and trousers tied with string round knees; oiled silk gloves; Service respirator; steel helmet; no hood.</i>	<i>Service oilskin jacket and trousers tied with string round knees; oiled silk gloves; Service respirator; steel helmet; no hood.</i>	<i>Same as subject B; but with an over-jacket and trousers of khaki drill put on after being soaked in water.</i>
<b>Observations before work.</b>	Felt quite normal. Pulse (standing) 84.	Felt quite normal. Pulse 80.	Felt cold when dressed Pulse 88.
<b>State of protective clothing.</b>	Dry.	Dry.	Wet outer suit.
<b>Work started—</b> 12.23. 12.26.	Shovelling chalk at 24 shovels per min.	Shovelling at 30 per min. Rested 3 secs.	Shovelling at 24 per min.
<b>Work stopped—</b> 12.38. 12.39.	Pulse 160. Pulse 144.	Pulse 128. Pulse 112.	Pulse 144. Pulse 108.
<b>Observations after 15 mins. work.</b>	Subject felt "very hot" very sweaty indeed; no respiratory difficulty though appeared distressed.	Subject said he felt comfortable but complained of heat and respiratory difficulty and was "uncomfortably hot."	Subject said he "felt reasonably warm"; breathing rather laboured otherwise not distressed.
12.45.	Outer fabric of protective suit wetted all over. Subject felt "immediate difference." Cool at once.	Wet flannelette placed over protective suit. Subject felt "very cold" at once.	Subject felt "normal" and looked normal.
12.46.	Felt "uncomfortably cool." Subject looked pale. Wrinkled skin on fingers noted on removing protective gloves.	Subject looked pale. Wrinkled skin on fingers noted on removing protective gloves.	Clammy hands and wrinkled fingers noted on removing protective gloves.

*Commentary on Results of 1st Field Test.*—This was a preliminary trial to work out a standard technique for further and more severe tests. It may be noted that the cooling sensation felt by subjects A and B on wetting the surface of the gas-proof protective garments after working confirmed the results of laboratory tests. Subject C, though wearing more

protective clothing than A or B, was obviously the least affected by the work, this being unquestionably due to the facilitation of loss of body-heat by evaporation of water from the outer wetted khaki drill suit worn by him.

The following acted as observers and assisted in this test :—

J. Wright, O/Cdt. Serjeant D. W. Boatman, O/Cdt. Serjeant G. L. Humphreys, O/Cdt. Corporal T. C. Thorne, O/Cdt. A. J. W. Warrack, M.B., B.S.

*2nd Field Test.*

*Date*: Tuesday, July 27, 1937. *Time*: 5 to 7 p.m. *Place*: Chalk quarry on hillside near Swanage. *Weather conditions*: Fine, sheltered from wind. Dry bulb 64° F., wet bulb 56° F.

*Routine*.—Six subjects clothed as detailed below were allocated sites in the quarry at which to work shovelling chalk with General Service shovels. Observers noted the pulse-rates, behaviour and sensations of the subjects before, during, and after, the period of work.



FIG. 4.—Subject "A" in 2nd Field Test.

*Subject A.—Service Protective Clothing. Dry.*

*Name*: O/Cdt. Serjeant G. L. Humphreys, aged 24.

*Ordinary clothing*: Shirt, shorts, socks, and leather boots.



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*Protective clothing* : Service pattern black oilskin jacket and trousers, and heavy Service decontamination overboots, Service respirator, steel helmet, yellow oiled silk gloves. Hood not worn (fig. 4).

6 p.m. : Started work.

6.5 : Shovelling at 28 per minute.

6.19 : 2 seconds pause.

6.30 : Felt very hot back and legs, 2 minutes pause.

6.34 : Pulse 130.

6.42 : Water thrown over subject and wet towel placed on back. After 45 seconds he said he felt much cooler.

6.44 : Stopped work ; pulse 144, not feeling well. On removing protective clothing it was found that shirt was sodden with sweat, and shorts were wet at waist and back.



FIG. 5.—Subject " B " in 2nd Field Test.

*Subject B.*—Service Protective Clothing Plus Outer Wetted Overalls and Hood of Heavy White Towelling. Wet.

*Name* : Major G. P. Crowden, R.A.M.C., T.A., aged 42.

*Ordinary clothing* : Shirt, shorts, socks.

*Protective clothing* : Service pattern black oilskin jacket and trousers

tucked into and folded over top of gum-boots ; Service oiled silk hood ; outer jacket, trousers and hood of heavy white towelling previously soaked with water ; oiled silk gloves ; Service respirator and steel helmet (fig. 5).

6 p.m. : Started work.

6.3 : Stopped 10 seconds. Towelling hood fell over eyes.

6.5 to 6.12 : Several short rest pauses of 3 to 5 seconds. Towelling over-trousers too long.

6.12 : Shovelling at 12 per minute.

6.21 : Back re-wetted with water.

6.30 : Felt like rest. Comfortable except for impeded respiration. Face hot. 2 minutes pause.

6.41 : Stopped work. Pulse 122. Does not feel hot but is sweating. Respirator causes discomfort. Clothing removed ; shirt wet also shorts at waist. The clothing worn felt very heavy and impeded working considerably. The towelling held a large quantity of water and hung loosely over front and legs.

*Subject C.—Service Protective Clothing. Dry.*

*Name :* O/Cdt. Serjeant S. Jackson. Aged 24.

*Ordinary clothing :* Shirt, shorts, socks.

*Protective clothing :* Service pattern black oilskin jacket and trousers worn over gum-boots thigh. Oiled silk gloves, steel helmet, and Service respirator. Hood not worn. Pulse resting standing before work, 86.

6 p.m. : Started work.

6.10 : Shovelling at 35 per minute.

6.22 : 10 seconds rest.

6.30 : Very hot, especially back and legs. 2 minutes pause.

6.42 : Stopped work. Pulse 180. Clothing removed ; shirt sodden with sweat.

*Subject D.—Service Protective Clothing Plus Outer Khaki Drill Jacket, Trousers and Hood Wetted with Water. Wet.*

*Name :* J. Wright. Aged 25.

*Ordinary clothing :* Shirt, vest, pants, and socks.

*Protective clothing :* Service pattern black oilskin jacket and trousers tucked into and turned over gum-boot tops ; yellow oiled silk hood and gloves ; outer wetted suit of khaki drill jacket, trousers and hood ; Service respirator and steel helmet (fig. 6). Pulse resting standing before work, 76.

6 p.m. Started work.

6.10 : Shovelling at 26 per minute.

6.13 : 5 seconds pause.

6.17 : 4 seconds pause.

6.19 : 3 seconds pause.

6.20 : Outer overall re-wetted in 90 seconds.

6.29 : 10 seconds pause.

6.30 : Paused for 35 seconds for observation ; stated he could go on indefinitely ; body feels cool except face.

6.36 : 24 seconds pause.

6.41 : 5 seconds pause.

6.43 : Stopped work ; pulse 80 ; felt quite all right on stopping.

6.44 : Felt perfectly O.K. ; only face hot. Shirt wet but vest underneath not excessive ; vest described by second observer as dry.



FIG. 6.—Subject "D" in 2nd Field Test and Subject "B" in 3rd Field Test.

*Subject E.—Light Infantry Protective Suit. Dry.*

*Name :* O/Cdt. Corporal J. B. Perkins. Aged 25.

*Ordinary clothing :* Shirt, shorts, socks, leather boots.

*Protective clothing :* Service infantry pattern oiled silk jacket and trousers inside light decontamination over-boots, oiled silk gloves, Service respirator, oiled silk hood and steel helmet.

6 p.m. : Started work.

6.10 : Shovelling at 21 per minute.

6.30 : Felt hot and clammy but said he could go on indefinitely.

6.44 : Stopped work. Pulse 120. Back felt very hot. Shirt wet.

*Subject F.—Protective Suit of Fabric-covered Rubber. Wet.*

*Name :* O/Cdt. Corporal D. M. Cushing. Aged 29.

*Ordinary clothing :* Shirt, shorts, socks.

*Protective clothing :* Fabric-covered rubber jacket and trousers worn



FIG. 7.—Subject "F" in 2nd Field Test and Subject "C" in 3rd Field Test.

over gum-boots and tied round ankle; hood of same material; oiled silk gloves; Service respirator and steel helmet. Fabric outer surface of protective clothing was thoroughly wetted with water before commencing work (fig. 7).

Pulse standing resting before work, 85.

6 p.m.: Started work.

6.4 : 8 seconds pause.

6.7 : Shovelling at 19 per minute.

6.15 : Shovelling at 25 per minute.

6.19 : Fabric of suit re-wetted in 45 seconds.

6.30 : Felt cool; face hot.

6.37 : Could go on indefinitely; fabric re-wetted in 30 seconds.

6.44 : Stopped work. Pulse 134. Felt perfectly O.K. Sweating round face only. Clothing removed and shirt found to be *quite dry*, also shorts. This subject stated that he normally perspires heavily. (*Note.*—O/Cdt. Cpl. Cushing was Subject A in the 1st Field Test in which he sweated profusely.)

*Commentary on results of 2nd Field Test.*—This test was designed to determine the advantage, if any, of maintaining a wet outer surface on protective clothing by means of additional water-retaining garments, or

a wettable fabric surface to the protective clothing itself. The six subjects used in this test were all fit men of ages ranging from 24 to 42 years.

Subject A, fig. 4, was dressed in Service protective clothing but without an oiled silk hood. He succeeded in working for forty-two minutes but was very distressed and bathed in sweat.

Subject C also wore Service protective clothing without a hood and had a similar experience to A.

Subject D was as completely clothed in Service protective garments as Subject A and wore, in addition, a Service oiled silk hood and outer hood of khaki drill, together with an outer jacket and trousers also of khaki drill (fig. 6). The khaki drill outer suit and hood were kept wet with water. In spite of the double layer of protective garments worn by D he was able to work unimpeded and, judging by his condition after forty-three minutes' work and his statements, he could have gone on working without risk of collapse from the accumulation of body-heat.

Subject F, fig. 7, who wore a suit of protective clothing of Service pattern but with an outer fabric surface wetted with water, worked hard for at least forty-three minutes and felt perfectly fit, and to the astonishment of the witnesses his shirt was found to be perfectly dry.

On the other hand Subject E, who wore a light infantry protective suit, was sweating profusely and felt hot after a similar period of work.

It remains to comment on Subject B, fig. 5, who wore in addition to Service protective clothing an outer wettable suit and hood of thick towelling which absorbed and held a great deal of water. Owing to the thickness of the towelling the evaporating water surface was further away from the oilskin and therefore less effective in cooling. Moreover, the additional weight and sagging of the wet towelling was a disadvantage which largely, if not entirely, discounted the advantage of evaporative cooling. From this experience it would appear that a light and very close-fitting wettable surface fabric layer should be used in conjunction with the oilskin or inner impermeable layer of protective clothing if full advantage is to be obtained from the evaporative cooling of water.

The following acted as observers and time-keepers: O/Cdt. Serjeant D. W. Boatman, O/Cdt. Serjeant R. West and O/Cdt. Corporal T. C. Thorne.

### *3rd Field Test.*

*Date:* Wednesday, July 28, 1937. *Time* 10.30 to 11.30 a.m. *Place:* Chalk quarry on hillside near Swanage.

*Weather Conditions:* Warm day, sunshine, sheltered from wind. Dry bulb 68° F.; wet bulb 62° F. Temperatures increased as sun rose.

*Routine.*—This test was designed to check and confirm the findings of the 2nd Field Test. Three subjects A, B, C (fig. 8), were allocated sites in the quarry, shovelling piles of loose chalk with General Service shovels as if mixing bleach and earth in proportions of 1:3 for decontamination of ground. Each subject was as completely protected as possible and

respirators and steel helmets were worn as before. Observers recorded the reactions of the subjects.

*Subject A. Dry.*

O/Cdt. Cpl. J. D. B. Perkins.  
25 years.

Clothing: Ordinary—

Shirt, pants, socks, and leather boots.

Clothing: Protective—

*Complete Service outfit only.*

Oilskin jacket and trousers with heavy decontamination over-boots. Oiled silk hood and gloves. Service respirator and steel helmet.

10.42 a.m. Started work.

10.51. Shovelling at 35 per min.

10.59. Rest pause after 17 mins. work.

Very wet with perspiration all over body. Little dizziness at times.

11.03. Mouth temperature 99.9° F.

11.11. Started work again.

11.17. Wet cloths wrapped over oilskin.

11.19. Stopped work and undressed. Shirt soaked in perspiration. Mouth temperature 100° F.

*Subject B. Wet.*

J. Wright. 25 years.

Clothing: Ordinary—

Shirt, vest, pants, and socks.

Clothing: Protective—

*Complete Service outfit plus outer wetted hood and suit of khaki drill.*

Oilskin jacket and outer jacket of khaki drill, oilskin trousers tucked in and folded over tops of gum-boots, and outer trousers of khaki drill. Oiled silk hood and outer hood of khaki drill. Oiled silk gloves. Service respirator and steel helmet.

10.42. Started work.

10.53. Shovelling at 26 per min.

10.56. Khaki drill over suit and respirator wetted. Felt comfortable.

Perspiration only on face.

11.19. Stopped work. Still felt comfortable. Hot on face. Undressed. Shirt dry. Mouth temperature 98.6° F.

*Subject C. Wet.*

O/Cdt. Cpl. D. M. Cushing.  
29 years,

Clothing: Ordinary—

Shirt, shorts and socks.

Clothing: Protective—

*Special outfit of Service pattern made of fabric-covered rubber which was kept wet.*

Jacket and trousers of fabric-covered rubber, the latter being worn over the gum-boots and tied at ankle. Fabric-covered rubber hood. Oiled silk gloves. Service respirator and steel helmet.

10.42. Started work.

10.55. Shovelling at 32 per min.

10.56. Fabric wetted including respirator fabric. Felt quite comfortable.

11.19. Stopped work and undressed. Shirt perfectly dry. Mouth temperature 98.1° F.



FIG. 8.—Subjects "A," "B," and "C," 3rd Field Test.

*Commentary on Results of 3rd Field Test.*—The 3rd field test in which three subjects, A, B, and C, shown in fig. 8, wore respectively Service protective clothing, Service protective clothing plus outer wetted garments and hood of khaki drill, and Service pattern protective clothing of wet fabric-covered rubber, confirmed previous experience and definitely proved the value of maintaining a wet outer surface on protective clothing during heavy muscular work. The day was warm and the quarry was sheltered from the wind but not from the sun. At 10.30 a.m. summer-time, shortly before the commencement of muscular work, the temperature conditions on the site were 68° F. dry bulb, and 62° F. wet bulb. These temperatures increased as the sun rose. As will be seen from the detailed record of the test, Subject A, who wore the dry Service outfit, showed signs of fatigue after seventeen minutes' work, which is quite in accordance with general experience. On the other hand, both Subject B, who wore wet overalls outside the Service outfit, and Subject C, who wore the wet fabric-faced rubber suit, worked hard and continuously for thirty-seven minutes and were apparently no more fatigued than if they had been wearing ordinary clothing permeable to air. The contrast between Subject A and Subject C

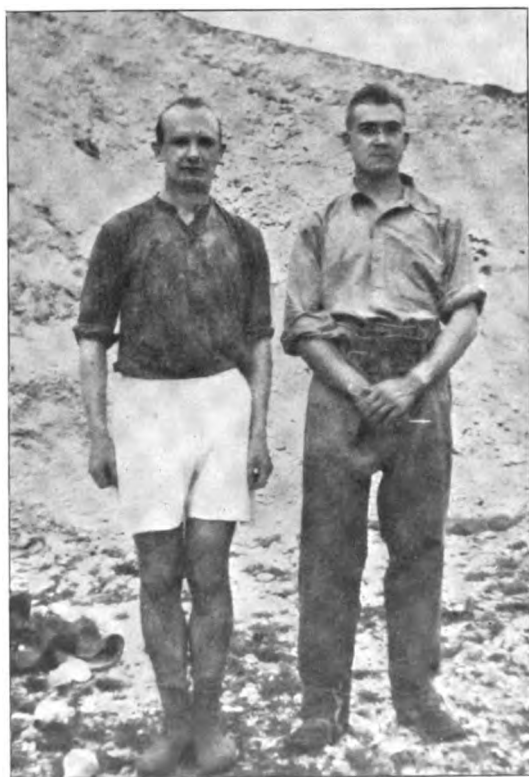


FIG. 9.—Subjects "A" and "C" after work in 3rd Field Test.

on removing the protective clothing after work is evident in the photograph fig. 9. The underclothing of A was soaked in perspiration while that of C was dry. The shirt worn by Subject B was also found to be dry after work and the mouth temperatures of both B and C were less than 99° F. In the case of A, 100° F. was registered although he had worked for only twenty-five minutes as compared with thirty-seven minutes' work carried out by B and C.

#### SUMMARY AND CONCLUSIONS.

(1) Laboratory experiments carried out in the air-conditioning room at the London School of Hygiene and Tropical Medicine and subsequent trials of gas-protective clothing of various types under field conditions at the camp of the University of London Officers' Training Corps at Swanage in July, 1937, have definitely proved the value of maintaining a wet outer surface on gas-protective clothing during the performance of heavy muscular work.

(2) The free evaporation of water which takes place from the wet outer surface of the protective garments increases body-heat loss provided the wet surface is in close apposition to the gas-impermeable layer of the protective clothing.

(3) As a result of severe tests on a number of subjects working under conditions of temperature and humidity as high as are likely to be encountered in the English climate, it is concluded that if the outer surface of gas-protective clothing is maintained wet during the performance of muscular work, then the accumulation of body-heat is prevented, sweating is much reduced and the risk of heat collapse, even under hot summer conditions, eliminated.

(4) In addition to indicating the general principles governing the effective use of artificial evaporative cooling, the tests carried out on various types of gas-protective clothing have established the following facts:—

(i) That an outer suit of wettable and wetted material, such as khaki drill, worn over Service protective oilskin clothing, enables muscular work to be carried out unimpeded and without discomfort under field service conditions in summer weather.

(ii) That gas-protective clothing of Service pattern but made up of gas-proof material faced with an outer wettable fabric layer periodically wetted is superior to the double garments described under (i) in facilitating the elimination of body-heat.

(iii) That a totally enclosing single-piece suit of gas-proof oilskin may be worn in safety provided an outer close-fitting single-piece suit and hood of wet fabric is also worn.

(iv) That any one of the protective outfits described under (i), (ii) or (iii), when used wet as recommended, is notably superior to Service gas-protective clothing consisting of oilskin only.



This investigation on the value of artificial evaporative cooling of gas-protective clothing arose out of a test carried out at the request of Messrs. Siebe Gorman and Company to determine whether the air exhaled from a respirator could be dried by calcium chloride and then used to ventilate and cool the body by passing it into a protective suit of special design. I am much indebted to Mr. R. W. Gorman Davis of Messrs. Siebe Gorman and Company for his active co-operation and for arranging, at short notice, for the manufacture and supply of various special garments needed for the tests as the investigation progressed; to J. S. Weiner, B.Sc., and W. R. Luxton for valuable assistance in the laboratory experiments; to the Officer Cadets of the Medical Unit of the University of London Officers' Training Corps who acted as observers and recorders in the field tests; and to those Officer Cadets who, together with J. Wright and A. E. Groves, acted as subjects and endured very considerable discomfort in some of the tests.

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“BAJILLED.”

By AL GEBELI.

(Continued from p. 182).

V.

We became an object of wonder to all the district and both Arab and Turk came long distances to see the caged infidels and with a pious hope that they might possibly share in some of the spoil.

The reputation of our Mandub had filtered through from the Aden Protectorate and a few came merely to look upon this worthy man. He relied, I am afraid, too much on the powers of his own diplomacy, strengthened by the threat of a mighty Britain in the background. But it was very obvious that placed as he was, his very life depending on the whim of his jailors, he had practically no freedom of action and news of the Allied victory not having reached these people and believing as they did the wild rumours spread by the Turks that France was completely destroyed and Britain was in the process of disintegration, the Sheikhs sneered at the suggestion that the British Lion could show its teeth.

The only hope was from outside and the force at Hodeida must be strengthened and expeditions sent to show the flag in the villages around Hodeida. Aeroplanes were an essential item with their wide range of action and the tremendous moral effect they would produce on peoples who had never heard of and far less seen one. And with this as a threat always hovering in the background, it made the programme of the new Political Officer at Hodeida more effective.

He commenced a campaign to undermine the authority of the Sheikhs who were abroad with us by inviting their Akils to Hodeida and winning their favour by giving largesse in the form of food and money, all of which had the desired effect of making the Sheikhs jealous. He soon let us know by letter the true characters of the main persons in the play. The Vali was described as a thorough scoundrel only equalled in perfidy by the would-be Holy Man. The former was definitely the chief obstacle to our release and was recognized as an outlaw both by the Turkish and British Governments because he refused to obey the Armistice terms. The P.O. wished the Mandub to impress upon this gentleman what advantages he would gain if he helped us; the P.O. himself would then entice him down to Hodeida and so get him out of the way. Another gentleman of whose existence we were ignorant until the receipt of this budget was an Arab, Yussuff Hussein, Kaimakan of Marawah, who is designated the instigator-in-chief of our arrest. Marawah appears to have been a nest of

conspirators: the Holy Man, Ali Bari, the hero of the raid on Hodeida, and the above-mentioned Hussein. But much better news, in fact the best we had received, was that airplanes had arrived at Kameran Island and also H.M.S. "Columba" at Hodeida with guns that could reach Marawah. The proposal to re-instate the Turk had been definitely turned down. Finally he ended by saying that everything in Hodeida was in readiness for war, but that he was staying his hand to give peaceful penetration a final chance.

On October 16 we had a visit from the Sheikhs and the Mandub told them that he had no longer power to negotiate, that matters had been taken completely out of his hands and they must deal direct with the P.O. at Hodeida. It became increasingly evident that the policy of the P.O. was having its effect. Mohammed Zaid returned from a visit to his country, declared he was tired of us and wished to hell we were out of it, while Ali Bari lingered when the rest had gone and told us he had been asked to Hodeida, but though quite agreeable did not think the other Sheikhs would countenance the visit. Then the Risaldar Major came with a tale that the Akils were disgruntled with the Sheikhs because they did not see any money coming their way and they were willing to assist in our release to the extent of producing 1,000 fighting men. Nearly twenty-four Akils, including some of Moh'd Zaid's, those of Baghawi Yahia Ali and Khussam, had signed that they would co-operate. Two-hundred men would be detailed to look after each Sheikh and see that there was no trouble from that particular direction; the remaining 200 would escort us safely to Hodeida. It would take fifteen days to prepare the plans.

Meanwhile the P.O. got one in on the Vali. He told him amongst other unpleasant things that there was no question of the Turks returning; that Turkey no longer existed as a nation. France was to have Syria and the League of Nations was at present deliberating what part of Europe or Asia should in future constitute Turkey and he, Nadim Bey, was only a private person and represented no one but himself. The Vali was much hurt at these caustic remarks, but excused the author of them on the grounds of his being only a Walid. Shaken at times the Mandub certainly was, especially when facts pointed unerringly to the Vali's duplicity, but he was soon soothed into renewed confidence by a few moments' contact with this arch intriguer. It all had the effect of breeding a degree of antagonism between the Mandub and the P.O. that went beyond this particular controversy to the policy of each in general.

The Sheikhs still said they would only deal with the Mandub, that the P.O. was not known to them. Yet we heard from several sources that they were offering the latter a safe conduct to and from Bajil, but that though the document bore their seals it was not considered binding because

the pledge had not been taken under oath before a Holy Man. Therefore treachery could be lawfully and honourably undertaken. The plot was that the P.O. when returning should be suddenly seized by two strange Sheikhs, carried to Marawah and held like us for ransom. We managed to warn the unsuspecting victim in time. He nevertheless still wished to see the Sheikhs and asked if this could be arranged at Hodeida. He also wanted to know whether a mobile column could force its way to Bajil and what opposition was likely to be met on the way.

At home the papers were full of our capture and we learned that our next of kin had been kept *au fait* with events by the Foreign Office, while questions had been asked in the House of Parliament.

Meanwhile the Imâm still persisted in his plan to march on Bajil, and had got as far as Hajeila. He had sufficient warriors to rout the Kuhra, wrest us from their grasp, see us safely to Hodeida and then deal with anyone who was wanting a fight. Every time news came of a threatened advance the Vali persuaded our Mandub to write the Imâm and beseech him to postpone his visit.

The Idrisi were being supported in their claim for Hodeida by the P.O. That port, lying as it does adjacent to their territory, was a prize the Idrisi have always coveted. They were mustered 500 strong ready to take whatever action might be required of them. This was all against our Mandub's policy, who was backing the Imâm, and after all it was for the very purpose of offering him first refusal that we had undertaken the blasted journey. When the fact that the Turks were never to return had finally sunk into the Sheikhs' crania they suggested an alternative scheme which received unanimous approval. The main points were that Hodeida was to become a Shafa'i town governed by Abdul Kadir, the Holy Man, and garrisoned by a small British force. All the arms collected by the British from the Turks at the time of their surrender were to be handed over to the Sheikhs.

In the whirlpool of these complexities we were often entirely forgotten. The deeper the plotting grew the greater the tendency to ignore our still small voices pleading to be allowed to return the way we had come.

On October 30 new hope was instilled into us by the news from the P.O. that the period allotted to peaceful penetration, which had served a very useful purpose, had now expired. The next step would be a show of force. The P.O. was most cheerful and optimistic. In his note he threw a further light on the Vali's complicity in our capture. Information had come from a rich merchant in Sana that the Vali and Imâm had long since devised a scheme to frustrate the post-war policy of Britain in these parts and to ensure the return of the Turks. It was agreed between the Vali and the Sheikhs that the Mission if an allied one should be allowed to pass, but if merely British it should be held up. These accusations were

further substantiated by Abu Hade, who embroiled the Holy Man also in the conspiracy, and he added that the latter could have got us out a long time ago if he had wished. The P.O.'s propaganda was beginning to take more and more effect ; there was increasing dissention between the Akils and Sheikhs and we heard that the Abus had been completely won over.

The letter further stated that Omar Saghir, the head Akil of Baghawi, had the tribe behind him and he was ready to go to Hodeida and arrange for our release. He would go this very night. Baghawi, learning of this, was naturally furious and showed his ill will by personally keeping guard over us, and our boys were continually on the *qui vive* lest he set upon us when we were asleep. Omar Saghir, however, in spite of his declaration,



The evacuation of the Turks from Hodeida after the Armistice.

remained in Bajil for some days and the differences between him and Baghawi reached such a climax that the latter threatened to shoot the former, who instantly drew his gambia and took the offensive. Before a murder could be committed they were both disarmed and bundled into the local jail and kept there until they could agree. Abu Hade, always quiet and imperturbable, came to us regularly to give us hope and to calm our Mandub on whom the strain and anxiety of the burden he had carried so long was beginning to tell. He said that he was backing up the Akil's conspiracy and was doing his best to assist the P.O. in his purpose.

On November 18 Abu Hade came with the Sheikhs' final demands—six guns, fifteen machine guns and 5,000 rifles. The Mandub lost his

temper and called the gods to witness that the Kuhras had had their chance; they would receive no money for their accursed obstinacy. Abu Hade took it all as a great joke and went off in roars of laughter well satisfied with his successful leg pull. On the 22nd a rumour spread through Bajil that a plane had flown over Marawah; had been fired on and had to return to the coast. This was excellent news. The townspeople were terrified and pannicky buddhoos are dangerous. We were forbidden to leave our quarters. Mohammed Zaid turned up with twenty soldiers to see that this order was carried out and prepared to put his men on guard duty. He proposed that should any further demonstration take place in the air we would all go with him to Gebel Dhamar. To this Abu Hade replied: "I am d——d if you do." He turned Moh'd Zaid and his men out neck and crop and forbade any one to come to see us. Everybody was at sixes and sevens. The Risaldar Major was prepared for any emergency. On the first warning a whistle would call all the Aden Troopers, who were to double over to our building, seize their rifles and be prepared for action. Omar Saghir would aid with 200 of his men. Abu Hade had increased our guard to ten and had all heights around Bajil picketed. He was playing up well. We loaded our revolvers once more and took our turn of watch at the stair head. That night the Holy Man, petrified with fear, pleaded that his house at Marawah might be spared.

On the 26th, after breakfast, while I was playing a game of chess with Neda, a game which I learned for the first time in Bajil, and of which we played a lot, we heard the hum of an aeroplane, so we rushed to the parapet and there it was flying at about 2,000 feet. When it was over Bajil there arose a murmur through the village, every hut poured forth its occupants, women and children rushed hither and thither screaming in abject terror. Soon the air was full of rifle shots and the shouting and pandemonium was awful. Some 600 armed men were firing at the "tiur" and at one time we thought they had scored a hit for the plane dropped some 500 feet, but after steadying it circled the village and then made off seawards. Abu Hade's soldiers came up the stairs to ensure that we did not escape through the air to the plane. When it had disappeared to the west the panic-stricken throng doubled along to our mansion shouting vengeance on our heads and waving naked gambias in the air. Soon rifles were going off and bullets pinging over the parapet, smashing against the walls of our chamber and crashing in through the windows. Some of the soldier guard took cover behind the parapet while we sat on the floor well out of the bullets' way. About ten men defended the stairs which the mob was trying to rush. Then the Holy Man came out of his hut carrying a long staff and harangued the crowd and finally all the Sheikhs arrived with their armed bodyguards, formed

a line, and using the butt ends of their rifles, beat back the mob. It was a ferocious battle. Yahia Ali, the hoary-bearded veteran, was well to the front, stripped to the waist, belabouring black skulls and shouting at the top of his raucous voice. Moh'd Zaid, Baghawi and Abu Hade were all there struggling to subdue the enraged and frightened throng. Soon naked backs were glistening with sweat and step by step the attackers were driven back.

The shooting had lasted twenty minutes but no harm resulted. There being no vantage point on our level from which to shoot the bullets all went heavenwards; those that had been fired through the windows had smashed and torn off the wooden roof of our rooms. Ahmed, Pop's boy, had a bullet through his lungi as he passed the opening of a drain in the roof up which some of the Arabs had been firing. The whole face of the building was splattered with bullets.

Ginger B., who had been attending the morning sick at the time, had a narrow escape. An Arab rushed in and fired point blank at him but one of Abu Hade's soldiers pushed his rifle up in time. The war-cry of those who made the assault on the stairs was the name of our Mandub. The Risaldar Major was attacked in his house, two shots were fired at him and someone tried to knife him. The Arabs were driven from the immediate proximity of our building and they gradually filtered away, an occasional shot indicating the direction they had taken. The Sheikhs then came straight up to see us; they had been badly shaken and looked as white as their black skins would allow. They persuaded our Mandub to send a message to the P.O. asking him to desist from any further demonstration of force, and just to rub it in a little the Mandub added that if it had not been for the Vali, the Holy Man and the Sheikhs we must assuredly have been killed. And so we tried to nullify the good done by this show of force.

In addition to the Sheikhs we had visits from certain individuals who had been prominent in the shooting and who came to see what score they had made. I see a note in my diary which can be taken for what it is worth. It is to the effect that "Through most of the show Neda and I played chess with revolvers at our elbows and I managed to check-mate him with his king driven against mine." I do not know what this particular move is designated in proper chess parlance. How cool in the face of danger we must have been !!!

The next day the scene entirely changed. During the night we were kept awake by the drumming of tomtoms in an adjacent hut. This hideous noise was to celebrate the marriage next day of a young Arab buck. Shortly after breakfast the bridal party commenced a parade of the village. The bridegroom was dressed in his very best and most colourful suiting and rode a prancing Arab pony with his purdahed girl

bride seated behind. In the centre of a howling, shouting, dancing crowd they processioned the village and halted for a short while under our building to give us the opportunity to add our contribution towards the cost of the wedding. This collecting of backsheesh was the main object of the parade. The village clown, dressed entirely in a straw habit, into the waist of which was stuck the jaw bone of a camel to represent a gambia, was the centre of attraction to the children, who roared at his antics. He carried a staff which he used as a rifle, taking off the attack on us yesterday. The pair were escorted to their hut, where hired slave-women sang at the tops of their voices, just as in the olden times of our history pipers were often detailed to play round a burning building to drown the cries of the wretched inmates.

Delegates from the Kuhra who had gone to Hodeida had now returned with terms for our release. Only two dissentients were reported—Moh'd Zaid and the Holy Man. The Akils of the former rushed upon him and he only saved his life by finding sanctuary in the Vali's house. In desperation he threw off his masheda and promised to do anything he was told. The Vali at once suggested his going to Hodeida and this he said he would do along with his friend Baghawî. But the Akils stepped in and said "No you don't, this is our little show and we won't have anyone sneaking in to Hodeida before us. If you go you will go with us, sowa, sowa." The Holy Man intervened, urging the Sheiks not to be too precipitate but to temporize a while, for by so doing they might win over the Akils again. Abu Hade rose to the occasion; he would have no waiting and no damned interference from the Holy Man or anyone else. The present arrangements must stand. The Holy Man remained obdurate and on no consideration would he allow us to go; whereat the Vali is said to have raised himself as high as his short legs would allow and marched out of the Holy Man's house, declaring he was still the Vali Valiat al Yemen and would collect his soldiers and return to the Imâm, and may the buddhoos of the Shafa'i learn a lesson when the forces from the hills and those of the British march in battle against them.

Abu Hade quietly went on preparing for our departure in a week's time.

The Imâm was reported to be on the war-path against the Idrisi.

On December 2 Abu Hade came to say we could get our heavy kit off in the evening. I, being the transport officer, set about laying it out in camel-loads in front of the building. A crowd began to gather and soon Baghawî, Moh'd Zaid and Yahia Ali were on the scene; they refused to allow me to continue and everything was returned to store. The excuse they gave was that Abu Hade was acting on his own with intent to spirit us away. Later in the evening rifle shots were heard to the east and a regular hubbub arose in the village, people running here, there and everywhere.



Rumours had it that Moh'd Zaid has been shot dead and that his soldiers were either rejoicing or coming to Bajil to avenge him. The truth, when we got it, was disappointing. This fierce Sheikh was unfortunately very much alive, he had collected his soldiers and was intent on mischief. Half the Aden troop joined us on the roof. Abu Hade was greatly perturbed, and wanted a loan of our rifles in case of trouble. Time passed but nothing happened. Then more firing; this time to the west. We were told it was Baghawi's men hastening to join Moh'd Zaid, but it turned out to be those of Abu Hade to the number of 200 coming at the double to our rescue and more to follow. So we rested once more in peace.

All that was required now to seal the terms of release was for the P.O. to put his signature to the document drawn up between him and the delegates—the Sheikhs awaited the terms—he had only to repeat his invitation to them all to go to Hodeida and promise that their reception would be a welcome and honourable one. This seemed good news. We felt we must get out soon or we would be embroiled in the war that was definitely coming. But next day we got a set back.

A hitch had occurred—the reason for which Neda learned from the Vali. A message it appears had come to the Holy man from Moh'd Zaid saying that on no account should the Mission be allowed to return as they must be punished. Thousands of Turks had landed in Italian Somaliland and were preparing to invade the Idrisi's country and over-run the Yemen. Abu Hade re-assured us that everything was all right. The P.O. agreed to whatever modification to the draft terms that our Mandub would recommend, and added that the Sheikhs had better look sharp as the British Government was getting impatient. Meanwhile an attempt had been made to assassinate Baghawi and this complicated matters still more. The P.O. must have learnt of the hitch and more or less blamed the Mandub for having thwarted his plans by continuing to ignore his advice not to have any dealings with the Vali or the Holy Man. He said that by his action the Mandub had indefinitely delayed negotiations. The General Officer Commanding voiced the same opinion yet we knew this accusation to be in the main untrue. The Mandub certainly trusted these two rogues, but for many days had ceased to discuss with them any but the P.O.s conditions.

On December 10 the Sheikhs came to tell us everything was settled and we were to prepare for the journey at 4 p.m. on Friday. So it had come at last, but still we were chary of taking the news for granted. The Sheikhs wanted the P.O. to realise that it was through no craft or skill on his part that this result had been achieved, but through their Mandub for whom they had an intense love.

They were undoubtedly afraid of the Imâm and the Idrisi, whose late

move we thought was responsible for things being brought to a head. The P.O. was certainly to be congratulated on having put the wind up them.

On December 12 we got the order to go and did not hesitate to take the hint. Loads were laid, camels hired and the Aden Troop given back their rifles. At 4 p.m. everything was ready, and amidst acclamations we mounted our mules and moved off. For half a mile the route was lined by a cheering crowd—all in their Sunday best. A band preceded us, playing as it moved at the double. On our right Yahia Ali led some 150 of his tribesmen who were leaping and dancing, tossing their rifles high in the air and catching them as they fell. Yahia himself cantered up and down



The tribesmen settled down to the steady tramp of 50 miles to Hodeida.

the front line on his steed, turning and twisting and whirling his rifle round his body. Baghawi with his tribe was on our left doing exactly the same thing. In the centre rode the Mission, led by the sedate Abu Hade and his father, between whom was our Mandub. The whole contingent numbered close on 1,000. Our hearts were bounding with joy, and the same high spirits seemed to pervade the Arabs. Hundreds of rifles were let off in abandon.

One special trick, which was somewhat disconcerting the first time it was tried on us, was for a wild soldier to creep up behind us, and let his bundook off at a level of our topees.

Neda was not an experienced muleteer, his control of the animal was

bad ; in trying to urge it on it bolted, making a wild plunge through a group of women who were knocked down and trampled under foot. Neda finished the mad gallop by taking a toss which, at first, we thought had fractured his collarbone.

By the time we got to Dar-el-Baki the effervescence had spent itself and the tribesmen settled down to the steady tramp of fifty miles to Hodeida. The Vali and the Holy Man had preceded us and were about one hour's journey ahead.

It was darkening as we neared Dar-Ahmed, and for a time before the moon rose we stumbled heavily on the rough track. So light hearted



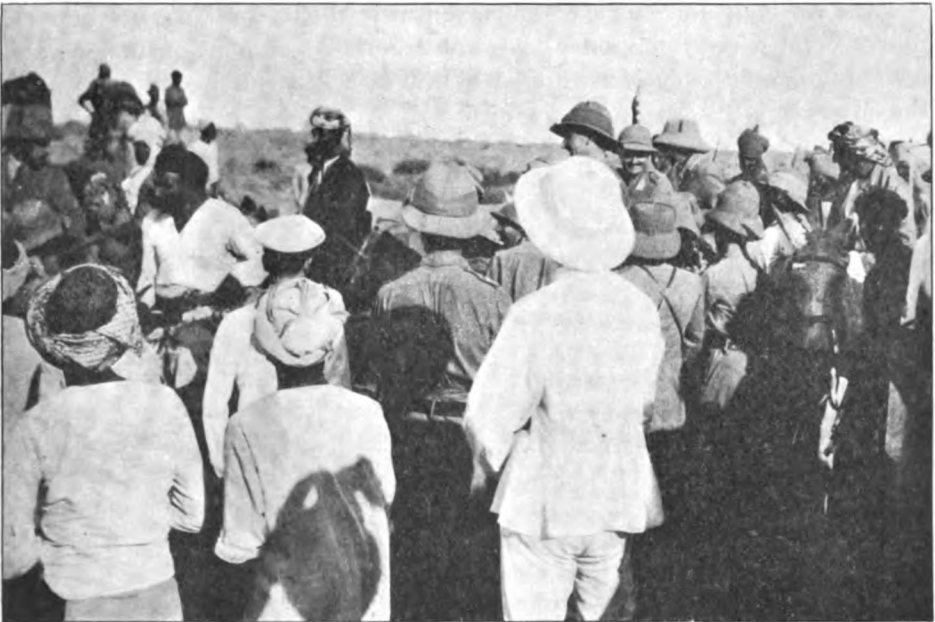
The tribes, raising a hue and cry and throwing their rifles in air, followed Abu Hade into Hodeida.

were we that Tannam seemed no distance off, and we arrived there as fresh as daisies. We rested for a while, during which time a great confab was continually in progress in the adjacent coffee house. Seemingly the dispute arose because the tribesmen were forbidden to go inside the wire at Hodeida with their rifles. Our Mandub declared that the authorities could not possibly allow the tribesmen in armed, and only a few as escort would be permitted. This did not please the tribesmen, who were not going to allow their Sheikhs to run the risk of being treacherously captured. So after arguing for a long time the Mandub was persuaded to send a letter by runner to the O.C. of the Hodeida garrison, asking that permission be given for the Arabs to enter armed. This done, we

got on the move again in the moonlight. I was ahead with Neda. At dawn, or just before it, we halted so that my companion might offer up a prayer to Allah.

At the wells at Zahalia we watered our mules and proceeded from here in a body to a sandridge overlooking Hodeida, where our baggage animals and a considerable number of tribesmen, about 1,000, had gathered.

When we arrived it was obvious something had gone awry. Yahia Ali was creating trouble it appeared. At this moment the messenger turned up with the reply from the O.C., Hodeida, which was to the effect that the Sheikhs and Akils could enter armed, but the soldiers were



So we returned to our friends and safety.

to place their rifles in a tent at one of the picquets, just inside the wire. Yahia had smelt a rat, and when he heard that his suspicions were confirmed he ordered a right about turn and back to Bajil. We got hold of Abu Hade and persuaded him to go ahead and mediate direct with the O.C., but when he started to do this the tribesmen, raising a hue and cry, followed on his heels leaping and loosing off their rifles, and before we knew well what had happened we were being squeezed through the gap in the wire amidst a howling mob of frantic Arabs. We were all in—arms and all, nothing less than machine gun fire could have stopped us.

So we returned to our friends and to safety.

That evening was the last we saw of the Sheikhs, they, with their Akils, were seated in a circle in the Consul's house, and when they heard that their Mandub was leaving them to their fate they were extremely angry, but with the exception of Yahia Ali all were too cowed to show their feelings. This old warrior raged and rampaged and showed he did not care a damn for anyone.

Our guard came down to the pier to see us off, and we had literally to fight our way to the dhow through a barrier of our Bajil friends?

The two miles of rough sea between the pier and H.M.S. “Cornwall,” on which we were sailing back to Aden, were sufficient to prostrate us in a very short space of time in our weakened state.

And so ends the story of an adventure which contains no heroics, much founded and unfounded fear, and an endless amount of intrigue and low cunning successfully countered by the skill and patience of our leader, the Mandub.

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## FEVERS OF THE TYPHUS GROUP IN THE BHIM TAL AREA, KUMAUN HILLS, U.P., INDIA.

BEING A REPORT OF AN INVESTIGATION CARRIED OUT INTO THE  
ALLEGED INCIDENCE AND NATURE OF TYPHUS GROUP FEVERS IN  
THE BHIM TAL AREA, KUMAUN HILLS, JULY, 1936.

BY CAPTAIN BASIL BLEWITT,  
*Royal Army Medical Corps.*

*(Continued from p. 167).*

### THE FIELD WORK.

Material was collected by a system of extended drives with a 400-yard frontage through the district, using coolies and a large number of dogs. Each drive was on a definite bearing which extended from one end of the area to the other, and was so arranged that an overlap occurred on the return drive. In this way the entire area was covered and should have resulted in no infected zone being missed.

The routine adopted for this portion of the investigation was as follows : From early morning until sunset was occupied in the collection of material ; at the conclusion of the day's drives the entire bag was counted and sorted into convenient lots, and the animal experiments commenced.

The methods of collecting material in the drives were as follows :

- (1) The deticking of all animals and cattle which fell within the drive ;
- (2) dragging the area with coarse sheets of white cloth and flags ;
- (3) deticking the dogs used at the conclusion of each drive.

These methods are simple and require little comment. As regards "dragging," this merely offers a large area of coarse material to which insects or ticks harboured in the local scrub or undergrowth may attach themselves, and is particularly designed for the collection of "seed" ticks, e.g. larvæ, etc. The dogs used were of especial value in negotiating difficult country, as they were deticked at the end of each drive and provided a large amount of material. Each coolie had one or more dogs in addition to a flag or a long sheet of material which he dragged with him through the undergrowth.

By these means some thousands of ticks, larval and otherwise, were collected from the area, but only 1,000 were retained for experimental purposes and were made up of a selected number from each zone.

The details of animal experiments and number of ticks used will be found in Table II.

TABLE II.

Animal series		No. of ticks unfed and innoc. per animal, intra-peritoneally	No. of ticks fed on each animal	No. of ticks fed and innoc. per animal, intra-peritoneally	Total ticks used per animal	Total ticks used
Guinea pigs	(10) ..	45	5	5	50	500
Rabbits	(4) ..	45	5	5	50	200
White rats	(6) ..	10	3	3	13	78
White mice	(6) ..	5	1	1	6	36
	(26)					814

From the above table it will be seen that in all 26 animals were employed and 814 ticks. As regards the animals, almost every type of laboratory animal was used which had been found by previous workers on the typhus problem throughout the world to respond in some appreciable manner to the known types of the typhus virus. Further, the ticks employed were a pooled collection representative of every zone in the Bhim Tal area, at least 60 per cent of which were either *R. sanguineus* or *Hyalomma aegyptium*. These two species had been incriminated by Megaw as the possible vectors, and his contention has been given a certain support by so distinguished an entomologist and student of tropical disease as Strictland in a brilliant study of the potential vectors (Strictland, 1927).

Further, *R. sanguineus* is itself the proved vector of the tick-borne typhus fever of the Mediterranean littoral, e.g. the Fievre Boutonneuse (Durand and Conseil). And finally it belongs to the same tribe as *Dermacentor andersoni* Stiles, one of the proved vectors of the tick-borne typhus fever of America.

All animals used were subjected to control, temperature and weight records, in addition to control Weil-Felix tests for some time prior to being employed in the experiments.

These experiments consisted of three stages: (1) The preparation of the emulsions of unfed ticks and their injection intraperitoneally into the experimental animal; (2) The feeding of ticks on the experimental animal for a number of days; (3) the preparation of emulsions of the fed ticks and their injection into their host.

*Details of the Tick Emulsion Injection.*—All ticks used were sterilized externally and then thoroughly ground in a sterile mortar and made into a suitable emulsion in normal saline and injected under strict asepsis intraperitoneally into the experimental animal. In certain cases the experimental animal received a blood injection intraperitoneally prior to receiving the emulsion; this was done in view of recent work which suggests that this procedure increases the chance of establishing a strain of the virus (Zinnser 1934).

*Details of the Feeding Experiments.*—For the feeding experiments fine wire gauze was used in the shape of a straw hat after the manner employed in these studies in America (Woolbach, 1919). The purpose of this portion of the experiments was two-fold—to investigate the potentialities of tick

transmission by feeding, and to obtain a re-activated tick virus should such exist, as suggested in recent studies of the tick virus in America (Parker, 1933). After three to four days feeding the ticks were removed from their host, emulsified in saline and injected into their host intraperitoneally when presumably a re-activated virus was introduced, if such were to be found in the ticks.

This completed the field work and all the animals, together with the equipment, were returned to the Brigade Laboratory, Bareilly, for the further stage of the investigation.

#### LABORATORY WORK.

The details connected with this portion of the investigation may be said to consist of a study of the reaction of the various animals to the feeding and inoculation experiments carried out at Bhim Tal. The details for the individual animal have been tabulated. The problem was investigated not only from a purely clinical aspect as revealed by daily temperature records and weekly weight records but also from the serological and histopathological side. All animals had a weekly Weil-Felix test carried out, and on the death of the animals smears and sections from suitable tissues were made and examined for the presence of rickettsia after staining with Giemsa as recommended by Woolbach, 1921, and Covell, 1936. A limited number of attempts at passage were undertaken. For each series of animals a control animal was maintained so that it was possible to check any apparent "reactions" in animals under experiment. The value of these control animals is particularly noticeable as regards ranges of normality in temperature. It is noticeable as far as guinea-pigs are concerned and to a less extent rabbits that the accepted standards as recorded in the "System of Bacteriology" (Privy Council, Vol. 19), are definitely not applicable to the plains of India during the hot weather. Covell considers a temperature of 102° F. in a guinea-pig as definitely abnormal. This is apparently true for the hill station in India; but in the plains the writer has found that this is not the case and it has not been possible to consider a temperature of 103° F. or under as evidence of a febrile response in guinea-pigs. Further it should be noted that wide fluctuations of two to four days' duration are quite common in normal guinea-pigs and rabbits and cannot be regarded as a specific febrile response unless the other lines of investigation confirm this. It may seem that unnecessary stress is being laid on a divergence from normal of only one degree; nevertheless the writer has been struck by the frequency by which the specific febrile responses of previous observers have involved no greater divergence; this one degree is of very considerable importance.

The two temperature charts are from guinea-pigs, one inoculated with blood from a human case and one with brain emulsion from a wild rat. The charts were kindly given to the writer by Covell as examples of the



## 244 *Fevers of the Typhus Group in the Bhim Tal Area*

specific febrile response in guinea-pigs infected with the typhus virus. From these it will be immediately appreciated how important this one degree divergence happens to be. These charts, when compared with our results, show that "even in Covell's" cases the febrile responses are in no way different to the normal fluctuation found in many guinea-pigs.

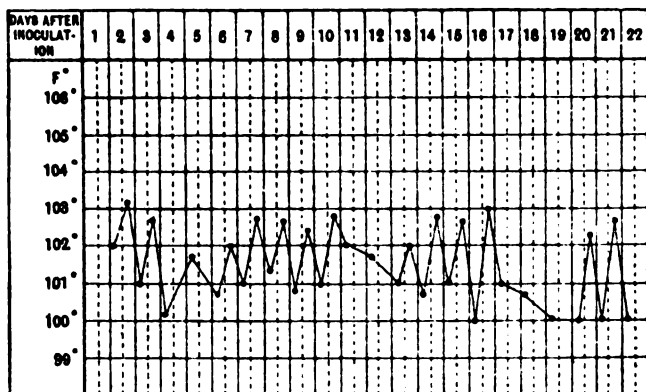


CHART I.—Normal temperature curve of a guinea-pig.

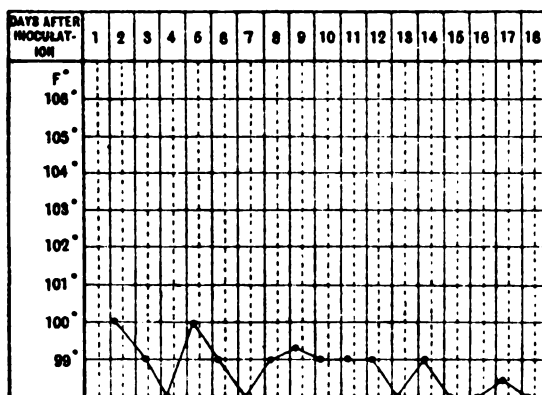


CHART II.—Normal temperature curve of a grey rat.

*"Experimental Tropical Typhus in Laboratory Animals" (Leuthwaite, R., 1930).*

In Covell's series rickettsiæ have been found and the Weil-Felix, though never impressive, has nevertheless been such as to suggest the possibility that these febrile responses were in fact abnormal and associated with a typhus infection.

It remains to consider in general terms the reactions of the various animals employed.

## THE REACTION IN THE EXPERIMENTAL ANIMALS.

It is clear that beyond slight fever in some of the guinea-pigs and rabbits on or about the end of the second week in no case was there evidence to warrant the assumption that it was secondary to a typhus virus infection—there is little to note about these reactions. They certainly are in no way similar to the reactions as noted by Anigstein (1933) and Woolbeck (1919). The few attempts at passage that were made were uniformly negative, in this connection it might have been better had brain emulsion been used more frequently instead of blood. This would have meant killing the animals before a thorough serological analysis could be carried out, and this was not done as frequently as the writer would have liked. There is little, however, to note about the reactions in any of the animals and certainly nothing to suggest they had acquired the typhus virus. In no case was any organism remotely resembling rickettsiæ seen in smears and sections from brain, testicle, tunica vaginalis, or spleen.

*(To be continued.)*

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## SIMPLE METHODS FOR COOLING MILITARY VEHICLES.

BY LIEUTENANT-COLONEL T. O. THOMPSON,  
*Royal Army Medical Corps.*

DURING the Waziristan Operations, 1937, it became obvious as summer approached that these activities would extend into or even beyond the hot weather, and that therefore conditions of extreme heat would probably be experienced by personnel in certain types of vehicles and by patients when being evacuated from the fighting area or from outside the area of operations.

As regards the latter, it has been found by actual practice that the most satisfactory method of evacuation for a majority of patients would be by air transport, but up to the present this has been limited to selected cases. This has been fully dealt with by another pen in a recent article [1].

Attention was therefore directed to two types of vehicles in which these conditions of extreme heat might, with most profit to the personnel concerned, be reduced to more reasonable levels. The two types of vehicles were armoured fighting vehicles on the one hand and ambulance cars on the other.

### A. ARMoured FIGHTING VEHICLES—LIGHT TANKS AND ARMoured CARS.

In the fierce sunshine of the barren frontier the temperature inside these vehicles becomes very high. In the role for which these vehicles are often used, they may have to stay stationary for long periods at a stretch in some exposed shadeless spot; they may even have to keep the engine running during long spells in one spot ready for immediate action; or they may have to travel at a very slow pace on low gear for considerable periods on roads exposed to a pitiless sun when external shade temperatures are reaching up to the 125° F. mark.

In all these circumstances internal temperatures of the vehicles become very excessive, and metal parts are so hot that the bare skin cannot be kept against them.

Many attempts have been made to cool them and many devices are employed internally for this purpose.

But additional cooling appeared to be desirable and, therefore, several ideas were considered. Covering exposed surfaces with screens of canvas or khus-khus (*see* p. 248) would undoubtedly give some benefit and was considered; but the risk of fire and interference with function vetoed this proposal. White or colour washing of exposed surfaces was attempted;

but, even with gum or size added to the mixture, the wash, after drying, would not stay put when metal surfaces became heated from within. This seemed to be a pity in view of the remarkable reductions which can be achieved by this simple method.

Aluminium paint was tried experimentally on one tank, together with an unpainted control. The results were sufficiently satisfactory to justify experimental adoption, which has now been continued as a limited general use in certain areas.

The main points which were observed were as follows :—

(1) External surfaces, which are heated from within to temperatures far above any external shade temperature, obviously do not require painting.

(2) The portion of the bonnet in front of the driver's field of vision should not be painted, because the glare off the polished surface interferes with driving.

(3) Painting all other exposed surfaces with special aluminium paint, containing a minimum of driers and oil, gives good reduction of temperature.

Over the driver's seat, at the position of his head, there is a reduction of about 5° F. when the external shade temperatures vary between 110° and 100° F. While in the turret, where the tank commander functions, there are reductions of 8° to 12° F. in temperature.

(4) Inquiry from tank crews working under field conditions indicates that temperature reductions are appreciable and satisfactory, and that the method is obviously advantageous so long as conspicuousness of the vehicle is of no importance.

If camouflage is necessary, this could be achieved by using patches of light colours, such as light green, cream, light blue, and very pale grey or khaki on the aluminium ground work. The results in reduction of temperature should not fall far short of those obtained by the plain aluminium paint.

#### B. AMBULANCE CARS AND LORRIES FITTED WITH BERRIDGE EQUIPMENT FOR STRETCHERS [2].

The distances covered by cars used for evacuations in the Waziristan Operations are roughly 60 miles from the area of operations to Bannu, 80 miles from Bannu to Kohat, 155 miles from Manzai to Bannu. With temperatures of 110° up to 122° F., and with hot, dry winds blowing, conditions inside loaded ambulance cars can be very trying for sick or wounded men.

Attention was therefore turned to methods for cooling these vehicles. It was realized that such methods should be capable of rapid adaptation to existing vehicles and should require as little structural alteration as possible.

After consideration of several methods, the use of khus-khus screens

over the whole hood of the car and over the front openings of the body was found to be effective, and these have now been provided for all vehicles employed over hot sections of the roads.

Khus-khus screens are the loosely woven mats of fibre made of coarse roots of riverside grass employed usually over the doors and windows of buildings during the dry, hot months of the year in all parts of India. The soft, loose fibres of the khus-khus are very absorbent of water. Water thrown, or trickled on to these screens is held in the substance of the screen, and, by evaporation, cools and moistens any transmitted air and any surfaces on which they are placed.

Experiments were carried out to ascertain the best method of using these khus-khus screens and the simplest method was finally adopted. Efforts to maintain a flow of water on to the screens from a tank of water fixed on the top of the body were discarded owing to the liability of the



FIG. 1.—Ready for the road. Ambulance cars protected by khus-khus screens.

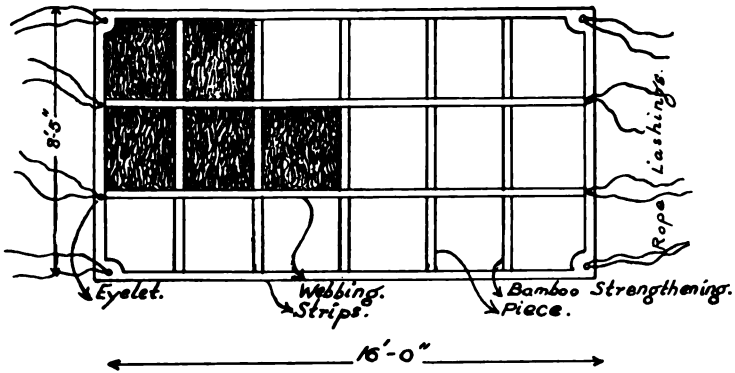
pipes to be blocked with fibres, and for the tank or the body to be damaged. Incidentally, on one road section a tunnel prohibits the use of any high excrescences above the hood of an ambulance car. Wetting of the screen has, therefore, to be done by hosing, or by hand-splashing from a bucket, before the start of a journey and during halts on the journey.

The results achieved during trials of these methods are shown in Appendices I and II, and a few results of temperature records during actual journeys of evacuation are given in Appendix III. Although the latter are not particularly convincing in themselves, compared with the more detailed and carefully recorded results shown during the trials, *vide* Appendix I, yet the general opinion is that definite benefit is derived from this method, especially during the dry, hottest periods of weather.

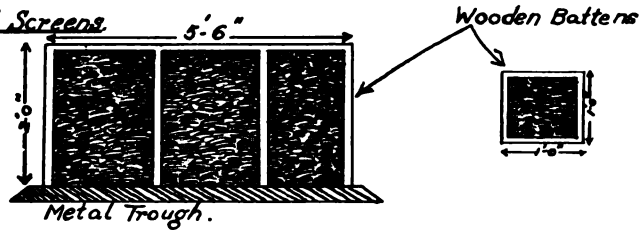
In fact, some patients complained of cold at the start of their journey, when the khus-khus was fully wetted and free evaporation was taking place.

DIAGRAM

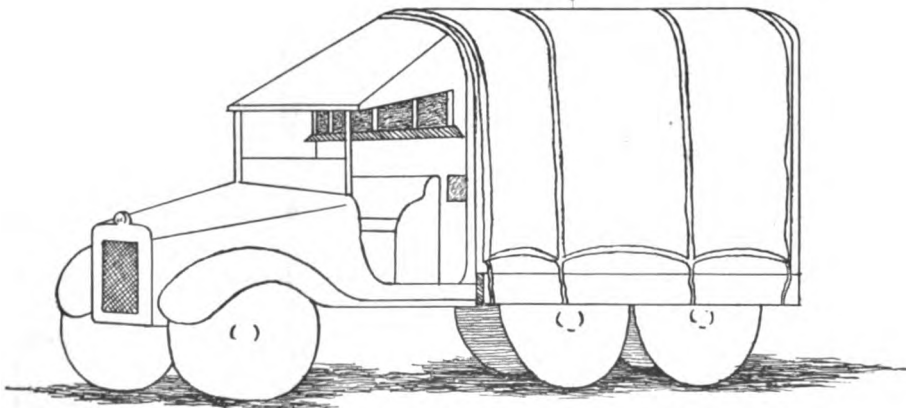
NR. 1. *Khus-Khus mat for main hood cover*



NR. 2. *Front Screens*



NR. 3. DIAGRAMMATIC VIEW OF SCREENS IN POSITION:-



The car drivers also found the cooling satisfactory. So much so that, even when the cars were stationary, they used the khus-khus-protected vehicles to sleep in during hot afternoons in preference to their chappar-protected tents or even barracks.

In one type of ambulance car with Weymann body, the body has a double skin, and the exhaust pipe projects up the side of the body and ends level with the top of the roof. On one of the initial runs from Bannu to Kohat, a car of this type was fitted with a khus-khus screen over the hood. This screen caught fire from the exhaust pipe. Fortunately the driver of the following car saw this in time to prevent any serious accident.

#### DESCRIPTION OF THE FINAL DESIGN.

##### (1) *Main Hood Cover.*

A simple rectangular strip or mat of khus-khus screening 8 feet 5 inches by 16 feet. (Subsequent experience shows that 15 feet would be better to allow for stretching and to ensure that the screen is lashed taut against the hood.) The khus-khus should be woven parallel to the shorter side to prevent rapid loss of water when the screen is in position.

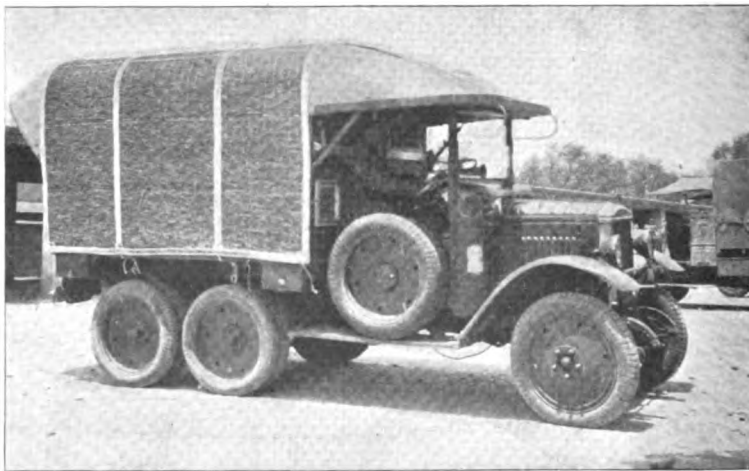


FIG. 2.—Ambulance car showing method of fixing khus-khus screen.

Strengthening side pieces of webbing are stitched round the outside edges and two strips down the length as shown in fig. 2 and strengthening corner pieces of webbing are also provided.

Five strengthening strips of bamboo are built into the fabric parallel to the shorter side.

Four brass eyelets on each shorter side are provided and lashing ropes, 5 foot lengths, are fixed to each eyelet.

Four cleats have to be fixed to the body on each side below the hood (see fig. 2).

*(2) Screens over Front Openings.*

(i) A single rectangular screen is provided, 5 feet 6 inches by 2 feet, with the khus-khus woven parallel with the longer side to prevent rapid loss of water when the screen is in position.

*Note.*—It is stated that khus-khus will not weave with a rectangular or criss-cross pattern, the staple is too short.

Strengthening edges and two central strips of webbing are provided.

The screen is fixed in position across the whole of the upper openings of the body and held by short wooden battens.



FIG. 3.—Showing front openings protected by khus-khus screens. One long screen for the two top openings with the water trough beneath, small square screens over the lower openings.

A single metal trough is fitted along the lower edge of the large screen to carry waste water away to the sides of the car—each end is sloped off as an escape spout.

*Note.*—A single screen has been employed for simplicity in the manufacture of the screen and trough.



(ii) Two screens, 1 foot square, for each of the lower openings, similarly made, are fastened in position. The existing wire-gauze screens are removed.

It is considered essential to deal with these two openings, because, although they are small, they directly affect the patients on the lower stretchers.

*Note.*—No trough is required below these screens.

The top half of the front windscreen should be removed to increase the draught, or it may merely be raised.

The driver and attendant have to be provided with goggles owing to the dust which blows in when the windscreen is wide open.

In conclusion, it is hoped that the account given above, together with the illustrations, will enable others to adapt these methods to vehicles under similar conditions when required.

My thanks are due to Major-General W. H. Hamilton, C.B., C.I.E., C.B.E., D.S.O., K.H.P., I.M.S., D.D.M.S., Northern Command for permission to send this account for publication. It was on his advice that khus-khus screens were first tried out. Also to Major R. G. Breadmore, O.B.E., A.M.I.M.E., R.I.A.S.C., Commanding the Experimental Section, and to Captain J. I. Vallance, R.A., at the Experimental Section, for their help in carrying out the experimental work and making the designs.

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#### APPENDIX I.

##### AMBULANCE COOLING TEST CARRIED OUT BY O.C. EXPERIMENTAL SECTION.

##### *Morris Ambulance Car.*

##### *Test No. 1.*

May 17, 1937. Tested as standard. Left out in the sun for four hours.

The vehicle was stationary.

Time	Temperature in shade ° F.	Sun temperature ° F.	Temperature in body ° F.
10 00	92	109	93
11 00	94	120	101
12 00	97	128	109
13 00	99	130	112
14 00	99	128	114

##### *Test No. 2.*

May 18, 1937. Tested with dry khus-khus placed over the body, allowing no air space between the khus-khus and the body. Left out in the sun for four hours. Stationary.

Time	Temperature in shade ° F.	Sun temperature ° F.	Temperature in body ° F.
9.30	90	119	92
10.30	92	126	95
11.30	94	131	100
12.30	97	138	105
13.30	97.5	132	107

Test No. 3.

May 19, 1937. Tested with dry khus-khus placed over the body with raves used in order to form an air space. Left out in the sun for four hours. Stationary.

Time	Temperature in shade ° F.	Sun temperature ° F.	Temperature in body ° F.
9.30	90	110	89
10.30	91	119	95
11.30	94	125	101
12.30	95	133	104
13.30	95	130	106

Test No. 4.

May 20, 1937. Tested with wet khus-khus placed over the body with raves used in order to form an air space. Left out in the sun for four hours. Stationary.

Time	Temperature in shade ° F.	Sun temperature ° F.	Temperature in body ° F.
9.45	90	110	81
10.45	93	127	92
11.45	94	130	94.5
12.45	96	132	95
13.45	96	120	97

APPENDIX II.

TEMPERATURE TESTS CARRIED OUT BY THE A.D.H. & P. NORTHERN  
COMMAND WITH SWING HYGROMETER—MAY 22, 1937.

(i) *Ambulance with complete khus-khus screens and water apparatus with canvas hood funnel.*

9 a.m.—12.30 p.m.				Very light S.E. air blowing		Bright sunshine
				Dry °F.	Wet °F.	
Temperature in shade	..	..		94.5	67.5	<i>Note.</i> —This is air temperature in the sun; not the ordinary so-called sun temperature
„ in sun	..	..		99	71	
Temperature in ambulance car with khus-khus wet				95	69	<i>Note.</i> —Without wetted screen temperature inside would have been anything from 100-105° F.
Temperature taken by swinging in centre of car						
Running at 15 miles per hour—						
After 400 yards	..	..		87.5	71	<i>Note.</i> —Running with breeze
„ $\frac{1}{2}$ mile	..	..		86	70	
Later	..	..		85.5	69.5	<i>Note.</i> —Against very light breeze
„	..	..		86	69	
„	..	..		85	69.5	
„	..	..		85.5	69.5	
<i>Halt and turn—</i>						
Shade temperature on road.						
Higher than in depot, i.e. now				100	69	

Return journey—				Dry ° F.	Wet ° F.	
Temperatures of ambulance car				88	72	<i>Note.</i> —Running with breeze Turning into Chaklala
Later	..	..	..	87	70	
„	..	..	..	86	70	

*Note.*—One screen has been woven with fibres horizontal, the other with fibres vertical. In the vertical screen the water runs to waste rapidly, the screen is half dry and there is an increase of 4° F. at 18 inches in rear of this screen compared with the horizontal fibre screen.

(ii) *Ambulance car with khus-khus screens but all funnel devices removed and top half of windscreen removed.*

Shade temperature .. .. .				102.5° F.		<i>Note.</i> —Wet bulb thermometer was unfortunately broken	
Temperature in car				Centre high ° F.	Centre low ° F.	Behind right screen ° F.	Behind left screen ° F.
Standing	..	..	..	95.5	95	94	94
Running 15 m.p.h.							
½ mile	..	..	..	87	88	83	84
Down wind later	..	..	..	85.5	88.5	82	84
Later	..	..	..	87	89	86*	83
Returning	..	..	..	87	89	86*	84
				87	89	85*	83

\* Screen became dry owing to blocking of feed pipe.

(iii) *Control test.*

*Ambulance car normal in all respects (except that it has foiltex on the front hood and back screen. It has been found that this makes no appreciable difference.)*

*No khus-khus or any other cooling appliance.*

				Centre high ° F.	Centre low ° F.
Car standing					
This had not been kept in the sun more than half-an-hour				106	102
Running at 15 m.p.h. Back screen down but central window open—					
½ mile	..	..	..	105	102
Later	..	..	..	105.5	101
„	..	..	..	105	100.5
To windward	..	..	..	105	100
Returning	..	..	..	106	101
„	..	..	..	106	101
Return to halting place	..	..	..	105.5	100.5

*Note.*—Air temperature by this time was about 103° F.

(iv) *Conclusion from this day's trials.*

There is a reduction of nearly 20° F. in the temperature inside an ambulance car fitted with khus-khus screens kept damp, compared with that in a normal car fitted with the ordinary double hood.

### APPENDIX III.

(i) *July 9, 1937*

		Inside ambulance car fully loaded ° F.	Air temperatures outside car ° F.
06.30 hours.	Start of journey	86	88
07.30	„	88	93
08.30	„	90	95
Official temperature records during the day—			
Maximum ..		103° F.	Minimum .. 81° F.
			Relative humidity .. 51

(ii) *June 26, 1937*

	Inside ambulance car fully loaded	Air temperatures outside car
	° F.	° F.
06.30 hours. Start of journey	97	104
08.30 „ First halt	97	108
11.00 „ Finish of journey	100	108

Official temperature records during the day—

Maximum .. 108° F. Minimum .. 84° F. Relative humidity .. 43

(iii) *June 27, 1937*

	Inside ambulance car fully loaded	Air temperatures outside car
	° F.	° F.
06.30 hours. Start of journey	90	100
08.30 „ First halt	97	102
09.00 „ Start of return	97	108
10.45 „ Finish of journey	100	109

Official temperature records during the day—

Maximum .. 116° F. Minimum .. 86° F. Relative humidity .. 35

*Note.*—The temperatures inside the ambulance car were taken while the car was *stationary*, not while it was running. The cooling effects of movement were therefore not effective at the time of reading.

## Editorial.

### THE STATE OF THE PUBLIC HEALTH.

IN an Editorial in the March number of the Journal we dealt with the Introduction and the Epidemiological Sections of Sir Arthur MacNalty's Report. Section IX is devoted to the Relation of Food to Health and Disease. During 1936 there were many noteworthy publications dealing with various aspects of human nutrition. The most authoritative are those of the Advisory Committee on Nutrition and of the Health Section of the League of Nations. In previous Annual Reports reference has been made to investigations on nutrition carried out under the supervision of the Ministry.

A study of the diets of sixty-nine working-class families in Newcastle-upon-Tyne was recently made. In the case of thirty-eight families the bread-winner was unemployed; in twenty-eight families he was in employment. The average diet of all these families was adequate in energy, protein and iron, but the supply of calcium and phosphorus was slightly under accepted standards. The average diet of the unemployed was inferior to that of the employed, especially as regards protein and fat. The unemployed purchased energy and protein at lower cost than the employed. The consumption of canned, prepared and cooked foods was higher amongst the unemployed than the employed. There was, however, little evidence of extravagant purchase of food or of serious decline of home cooking in any of the families.

The hæmoglobin contents of the blood were practically the same in both groups. There were no differences in the comparative heights and weights of children in any of the groupings; the employed men were heavier than the unemployed.

It has been necessary to introduce some modification in the physiological tests of efficiency. The response of pulse-rate to exercise could not be assessed as regards efficiency until it was known what were the limits of variability in subjects of good physical condition. The results so far obtained do not suggest that the method will prove a simple and reliable means of assessing physical fitness.

In the November number of the Journal, 1937, we gave in considerable detail the views of the experts of the League of Nations Committee on the tests for physical fitness. The great difficulty experienced was the lack of standards. Professor Bigwood pointed out that the significance of the tests themselves would have to be worked out, and thereafter accurate data on the requirements of the body in respect of protective foods and the variability of such needs in relation to climatic conditions.

The Milk (Special Designation) New Order which came into operation on June 1, 1936, involved changes; the new licences are now issued by

the authorities empowered to do so by the Act, the Ministry retaining control until December 31 of licences previously issued by the Department. Difficulties in administration arose in connexion with refusals to grant or renew licences to use the designation "accredited" milk. Refusals were generally based on deficient floor space, unsuitable plant, height of cowsheds being inadequate, ventilation inefficient, unsatisfactory bacteriological results. The large increase in the number of licences for the production of accredited milk made it desirable that as great a degree of uniformity as possible should be attained in regard to requirements of equipment and methods. The Ministry's milk inspectors are visiting authorities with the object of assisting them to obtain uniformity.

In connexion with tuberculin tests, regulations as regards the marking of animals with legible identification numbers and keeping herd records are indispensable for control, especially as there are new restrictions concerning animals added to licensed herds. New additions to the herd must be segregated for two months after the first test and then pass a further test before they are added to the non-reacting herds.

In order to enable accredited herd owners to eliminate reactors and thus qualify for tuberculin tested licenses without serious disorganization of the milk supply, the 1936 Act allows reactors discovered in the herd to be retained, but no reactors from any other herd may be added.

The incidence of mastitis in licensed herds appears to be comparatively frequent, especially on farms on which mechanical milking appliances are employed. The Milk Order requires all licensees immediately to remove and effectively isolate from their herds every animal affected with this disease. As a preventive measure, milking machine test cups should be rinsed with clean cold water and then immersed in boiling water after each cow is milked. The use of strong disinfectants is discouraged as they are comparatively useless for destroying infective material and may be introduced into the milk.

Attention is now directed to securing efficient pasteurization of milk, as tubercle bacilli have been found in milk declared to have been pasteurized. The phosphatase test is a valuable supplement to the inspection of the plant, and a positive result affords a convincing test that pasteurization has not been efficiently carried out.

The Milk Order, 1936, prescribed a methylene blue reduction test instead of the plate count test for raw graded milk. The method of carrying out the test has been described in the Ministry's Memorandum 139 (Foods), and the directions should be meticulously observed.

The nutritive value of pasteurized milk has been investigated by the Milk Nutrition Committee. The results of the examination of more than 6,000 children seem to show that supplements of two-thirds of a pint of milk have had a definite and that of one-third of a pint of milk a less definite effect on the rate of growth.

Evidence that there is no nutritive difference between raw and pas-

teurized milk continues to accumulate. An investigation at the National Institute for Research in Dairying, Shinfield, and at the Rowett Institute, Aberdeen, shows that the nutritive value of milk is not affected by pasteurization so far as its general nutritive properties or its protein, calcium, phosphorus and vitamin A are concerned. Vitamins B and C suffer some loss, but the loss in vitamin C is not due entirely to pasteurization. Milk which has never been exposed to light can be pasteurized without any loss of vitamin C. Vitamin C becomes reversibly oxidized on exposure to light, and it is only this oxidized form which is destroyed by pasteurization.

An experiment to compare the nutritive value of pasteurized and raw milk was carried out on a number of calves. The average increase in weight of the group fed on pasteurized milk was slightly greater than that of the group fed on raw milk. Skeletal development was good and at no time during the experiment could a professional observer distinguish between the two groups.

As regards tuberculous infection 24 out of 36 calves fed on raw milk reacted to the tuberculin test, and tuberculous lesions were found in 23 of the calves on post-mortem examination. Only one calf out of 37 fed on pasteurized milk reacted to the tuberculin test but exhaustive post-mortem examination and inoculation of glandular material into guinea-pigs failed to disclose the presence of any tuberculous infection.

Under impurities in food attention is drawn to the facing of tea with talc, gypsum, and colouring matter such as Prussian blue, which may contain excessive amounts of arsenic. The practice is prohibited in many countries and would constitute an offence under the Food and Drugs Adulteration Act, 1928.

Cases of lead poisoning have been found to be caused by the drawing of beer from barrels through old lead piping. If the beer is allowed to stand overnight in the piping, it may contain as much as five parts per million of lead. Lead pipes should not be used for the conveyance of beer: block tin pipes are free from objection but are expensive.

In the Annual Report for 1933 reference was made to the contamination of sardines with lead. It was decided by Port Medical Officers of Health that sardines should not contain lead, but the trade pointed out that time would be required in their methods of canning to attain this freedom from impurity. This resulted in action not being taken until lead exceeded 20 parts per million, though warning might be given when the lead approached this limit. Later it was agreed that after July 1, 1937, action would be taken when consignments of sardines contained more than five parts of lead per million. This was allowed only for a limited period. The ultimate requirement being that sardines should be free from lead.

For the detection of small quantities of lead in food, Dr. Monier Williams has found the most satisfactory method is one which includes extraction with dithizone, precipitation of lead as sulphate and determination colorimetrically as sulphide. The method is easy to carry out and is capable of detecting lead of the order 0.005 mgm.

It has been the practice to add stannous chloride to Demerara sugar with the object of fixing the natural colouring matter. Analysis of sugar on the market has revealed the presence of tin up to three or more grains per pound. The Royal Commission on arsenical poisoning stated that "chloride of tin appears to us an objectionable and unnecessary addition to sugar and we are of opinion that it should no longer be used."

It is considered desirable that bacteriological examination of specimens from cases of food poisoning should be carried out in one laboratory so that the results from all over the country can be correlated. The Ministry's laboratory has for the past twelve years carried out this work and it is hoped that Medical Officers of Health outside London will continue to submit specimens from suspected food poisoning, particularly the excreta of the sufferers, to the Ministry's laboratory.

In 1936 there were 82 outbreaks of food poisoning compared with 137 in 1935. In thirteen outbreaks food poisoning could be excluded; in eight outbreaks infection with dysentery bacilli was the cause; in seven cases some species of dysentery bacilli were isolated from patients; in one Flexner bacilli (type Z) were obtained.

Salmonellas were isolated in nineteen outbreaks. Of the remainder twenty-six were considered to be due to a toxin already elaborated in the food as a result of bacterial growth, and not to *Salmonella* infection. In ten instances cultures of staphylococcus, usually *Staph. aureus*, were in such numbers as to suggest that they had produced the gastro-intestinal irritant responsible for the symptoms.

Little progress has been made towards identification of the toxin; it resists boiling and is probably of a simpler chemical character than the toxin of diphtheria, tetanus, or botulism; but no laboratory test exists for its identification except animal experiment. Dolman *et al.* report that intraperitoneal administration to kittens may be a more reliable method of detecting it than administration by the mouth to monkeys.

There were two examples, each involving over 100 cases of sickness and vomiting, in which milk was the probable cause, but in neither could anything in the bacterial content of the milk be held responsible, nor could any abnormality in the feeding or condition of the cows account for the effect of the milk. Such outbreaks are of frequent occurrence and offer a difficult problem for elucidation.

The largest outbreak (approximately 130 cases, none fatal) due to *Salmonella* infection of milk, occurred in Wiltshire and chiefly affected children. The cause of the outbreak was an infection with the Dublin type of *Salmonella*, which was isolated from the milk and from one of the cows supplying it.

An investigation of the *Salmonella* infection of rats by Dr. Khalil illustrates the importance of the animal reservoir in which the various *Salmonella* types maintain their existence. In Liverpool examination of rats between January and March gave 44 positive results out of 250 rats



from the City and Port; 24 were *aertrycke*, 16 *enteritidis* and 2 *Newport*. There is reason to think that the *enteritidis* (Gaertner) is the rat type in particular, just as the Dublin type is bovine.

The Committee appointed by the Minister to consider the cost of construction of hospitals issued its first report, entitled "The Acute General Hospital," in February, 1937.

The Committee was concerned primarily with cost and had to consider whether it was desirable to establish standards which would lead to greater uniformity in the cost of the construction of hospitals. They point out that annual costs of maintenance and operation are of more importance, economically, than first cost and reductions in first cost may be the reverse of economy if they increase costs of operation or maintenance, or lead to inefficiency.

The Committee mention the fallacies of comparing different hospitals on a basis of "cost per bed" and the difficulty of arriving at any figure which could be regarded as "normal present cost." Under the heading, "Site and General Layout," the question of high *versus* spread-out low buildings is discussed and the conclusion is reached that there is not much to choose between the two from the point of view of cost of construction and the choice should depend on other considerations. Some of the more important conclusions and recommendations relate to in-patient accommodation (standards for wards and dimensions of ancillary rooms), the composition and dimensions of operating theatre suites, residential accommodation for medical and nursing staff, and methods of construction.

In 1935 the London County Council adopted certain standards for wards of general hospitals: (1) *Width* of all types of wards erected in future to be 26 feet; (2) *Acute wards*, including maternity, tuberculosis, venereal diseases and acute mental to have 8 feet *wall space* per bed, and *height* for wards up to 50 feet in length to be 11 feet and for wards exceeding 50 feet in length to be 12 feet; (3) *Chronic wards*, wall space to be 7 feet per bed. If offensive cases are treated, 8 feet per bed. Height as for acute wards; (4) *Cot wards*, wall space per bed, 7 feet. Height as for acute wards; (5) *Single bedded wards*, 11 × 10 feet. Floor space for a nurse's bedroom was to be 99 square feet and for a Sister's room 110 square feet.

Research in the Ministry's Laboratory has consisted in the study of antigenic components of food poisoning bacilli; the serological classification of hæmolytic streptococci of the *Str. pyogenes* group, and methods of testing the sterility of surgical catgut.

During the year 1936 many important researches have added to our knowledge of the prontosil group of drugs. Prontosil is now marketed in three forms: "Red Prontosil" which corresponds to the original prontosil, "Prontosil Soluble" which is a sodium derivative, and "Prontosil Album" which is a brand of p-aminobenzenesulphonamide (sulphanilamide).

Sulphanilamide is bacteriostatic and bactericidal both *in vitro* and *in vivo*. It has been shown to be produced from prontosil by reduction of the dye in the body; a considerable amount of it is excreted when prontosil is given orally or by injection, and the clinical results are not inferior to those of prontosil itself. It was early ascertained that the original forms of prontosil were inactive *in vitro* and only became active in the body on reduction to a simple substance, and the work of Tréfouel, Nitti and Bovet, and Fuller showed that this active reduction body is p-aminobenzene-sulphonamide (sulphanilamide or sulphonamide).

Colebrook and Kenny have treated 64 cases of puerperal sepsis of all kinds with prontosil and prontosil soluble with 3 deaths—a mortality of 4·7 per cent contrasted with 16·6 to 31 per cent which were the ratios in Queen Charlotte's Hospital in the pre-prontosil years 1931-35.

Prontosil has been used with good results in meningococcic meningitis. It has also been tried in scarlet fever and in some surgical streptococcal infections.

At first sulphanilamide was thought to be of low toxicity, but further experience has shown that cyanosis due to sulphæmoglobinæmia is of not infrequent occurrence and may have serious results. Agranulocytosis cases have been reported after para-aminobenzenesulphonamide. Other toxic effects which have been noted are recurrent fever, tachycardia and indications of renal irritation.

It is suggested that when sulphanilamide is employed sulphates (i.e. magnesium or sodium sulphate) should not be given and regular spectroscopic examination of the blood should be made. Care should be taken in giving the prontosil group to cases of renal insufficiency.

The dangers of cosmetics are dealt with in some detail in Sir Arthur MacNalty's report.

It is pointed out that Sabouraud in 1905 drew attention to the use of rouge crayons as a possible cause of eczema. Lipstick cheilitis was described in 1928 by Andry and Valdique. It is a dermatitis or eczema of the lips characterized by pruritus and swelling of the mucous membrane often accompanied by vesicles or even bullæ. Swelling may extend to the face and neck. When the use of lipstick is stopped the affection generally disappears in ten to twelve days. A scientific diagnosis may be made by smearing a little of the suspected lipstick on the skin of the forearm below the bend of the elbow. A positive reaction is indicated by an erythematovesicular eruption within twenty-four to forty-eight hours. The dye ingredient eosin is most often at fault. Tolusafranine has been reported also as the cause. In other cases the perfume, methyl heptene carbonate, was the irritating agent.

Hair dyes of vegetable origin would appear to be innocuous, but those depending on paraphenylenediamine may cause eczema of the scalp and œdema which in one case spread to the glottis and caused death. It may

be the cause of dermatitis following the use of furs, the so-called "fur dermatitis." In Germany the use of this chemical is forbidden.

Sometimes dermatitis may be due to a depilatory for the removal of axillary hair. The most dangerous depilatory is thalium acetate.

There are many innocuous ingredients which can be used in the composition of grease paints so that the use of lead is unpardonable.

Slimming should not be undertaken with drugs except on medical advice. Dinitrophenol should not be taken under any circumstances.

The discovery of new preparations of insulin has profoundly modified the treatment of diabetes. Protamine insulin was introduced in 1936 by Professor Hagedorn, of Denmark, under the name of "Insulin retard." Protamine is a simple protein derived from fish sperm, and Hagedorn found that its addition to insulin resulted in a precipitate that was more slowly absorbed from the subcutaneous tissues than insulin hydrochloride. Its spread-out effect ensures a fasting blood-sugar level throughout the night. Hagedorn recommends that protamine insulin should be given in the evening and insulin hydrochloride in the morning to control the sugar resulting from breakfast.

In 1935 Scott and Fisher found that crystalline insulin was a true compound of insulin and zinc and they showed that the delayed action of protamine insulin depended on the presence of zinc and allied metals in this preparation. The addition of traces of zinc and the adjustment of the pH to 7.2 resulted in the formation of a zinc-protamine-insulin compound which was more stable than Hagedorn's protamine insulin and had a more prolonged effect on blood-sugar. The exact nature of this new preparation is still not completely known, but the stability of the suspension is well established. It is considered too early to tell in what manner ordinary insulin, protamine insulin and zinc-protamine-insulin will be employed in the future in the treatment of diabetes.

For some time workers on diphtheria have endeavoured to find a method of producing a solid immunity by one injection. Alum-precipitated-toxoid (A.P.T.) seemed likely to fulfil this aim; but the results obtained by different observers have varied considerably and have not usually compared favourably with those obtained by three injections of toxoid antitoxin floccules (T.A.F.). In 1937 Claus Jensen and his co-workers employed a special form of A.P.T., the first dose of which is given in the ordinary way by subcutaneous injection; but the immunity thus produced is reinforced by the installation of a few drops of the same preparation into the child's nostrils. Jensen's results which are supported by antitoxin determinations, both in children and adults, show that as solid immunity can be conferred by this method as by A.P.T., with the advantage of only one injection ("one shot method"). If subsequent work in Denmark confirms Jensen's results it is considered that the prophylaxis of diphtheria will have made a notable advance.

In the subsection treating of water supplies, it is stated that water undertakers who possess supplies from strata such as the chalk in areas which are becoming increasingly built over, have a grave responsibility to the consumers. Analysis of the water at frequent intervals will not suffice to ensure that sudden unexpected pollution of the supply will be recognized early enough to prevent an outbreak of intestinal disease. In some areas it is certainly necessary to make daily examination of the water in order to be sure of recognizing the first indications of danger.

The Sanitary Commission for Aerial Navigation has solved some thorny problems in connexion with the opening of new air routes in territories recently infected with yellow fever, or in which the virus of yellow fever has been demonstrated by means of the mouse-protection test. A new air route from Lagos to Khartoum, which cuts right across suspected territory in Africa, has been adequately protected by the establishment, where necessary, of anti-amaril aerodromes and by the immunization against yellow fever of the crew operating the aircraft along these routes.

The question of conveying disease by infected mosquitoes has given rise to anxiety in various countries. The Commission has had to consider the various methods of destroying mosquitoes in aircraft without unduly interfering with the flight and with the safety and health of the crew and passengers.

Atomization of insecticide liquids containing a base of extract of pyrethrum dissolved in kerosene is at the moment considered the most practicable means of destroying mosquitoes. The addition of carbon tetrachloride to the kerosene is very effective and the mixture does not give rise to any irritation of the mucous membranes and is not inflammable.

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## Clinical and other Notes.

### A SEVERE CASE OF ECLAMPSIA TREATED BY LUMBAR PUNCTURE.

BY MAJOR L. S. C. ROCHE, M.C.  
*Royal Army Medical Corps.*

IN view of the grave prognosis, the critical condition, the eventual recovery and some special points in the treatment, the following case is considered worth reporting.

Mrs. R. was admitted to the Helena Hospital, Shorncliffe, in the late second stage of labour on July 20, 1937, at 7.30 a.m., having travelled in a motor ambulance car from an out-station twenty-five miles away.

She was a 21-year old primipara in a very sound state of health and with no history of any kind of fits or of other serious diseases.

Her pregnancy had been uneventful and at no time showed evidence of renal trouble, the urine having been tested for albumin at weekly intervals during the last two months before term. It must be noted, however, that though she had kept herself regular with mild aperients she had no motion during the two days preceding her confinement, nor was it found possible to give her the customary enema on admission, labour being too far advanced.

An hour and a quarter later she was delivered normally of a seven and a quarter pound female baby. Four hours afterwards she complained of violent headache, and fifteen minutes later she had a severe convulsion lasting about three minutes.

By the small hours of the morning of the second day, i.e. during the period of fifteen hours, she had had fourteen fits, all very violent and accompanied by extreme cyanosis during the tonic stage, each lasting about three minutes, and leaving the patient exhausted. After the third fit there was no return to consciousness during the intervals, in fact after the sixth fit coma was deep, breathing stertorous, some cyanosis was present and mucus accumulated in the fauces.

The urine after the first fit contained no albumin. This appeared later but never in large amounts.

The blood pressure reading was 190/90 mm. hg. The temperature never rose above 99° F. and the pulse rate, after the later fits, was never less than 100.

By this time the following measures had been adopted without avail :

(1) At first bromides and opiates by the mouth, followed later by four-hourly hypodermic injections of morphia; (2) copious high colonic lavage which was returned clear; (3) gastric lavage with half an ounce of magnesium

sulphate left in the stomach ; (4) venesection ; (5) alkaline intravenous saline ; (6) atropin hypodermic injections to control mucus formation.

The prognosis was then considered extremely grave in view of the following points : (1) The onset of convulsions occurring after delivery ; (2) the severity and long duration of the fits ; (3) the comparatively large number of fits at first at about two-hourly intervals, but with shortening intervals as the case progressed ; (4) the advent of deep coma ; (5) the high blood-pressure ; (6) the signs of cyanosis, shock, and incipient pulmonary oedema. In fact the case seemed hopeless.

It was then that the probability of raised intracranial and intrathecal pressure suggested itself. This pressure might be relieved by lumbar puncture, as in cases of status epilepticus.

This was accordingly carried out. The cerebrospinal fluid was very definitely under pressure ; it poured out from the needle and it was not until fifty cubic centimetres of cerebrospinal fluid (about half the total normal amount) had been released that it dripped at the normal rate.

Only two more fits occurred shortly afterwards ; both these were comparatively mild and transient, lasting only half a minute.

Meanwhile the patient was still in imminent danger because of shock and prostration (pulse 140, weak) and because of impairment of respiration, partly from shallow breathing (? morphia) and partly from filling of the bronchial tubes with secretion.

All hopes of saving the patient's life had been given up, but as a last resort the following measures were adopted : (1) The foot of the bed was raised to encourage secretions to run into the pharynx whence they were constantly swabbed away ; (2) more atropin was given ; (3) continuous inhalation of oxygen was begun ; (4) periodical inhalations of carbon dioxide, particularly through the nostrils, at ten-minute intervals. These " blasts " of carbon dioxide not only deepened respiration, but also momentarily brought the patient out of her coma, made her cough and improved her circulation ; (5) coramine 1·7 cubic centimetres repeated with digitalin 1/100 grain after an hour to stimulate and maintain the circulation.

These measures were so successful that three hours after their institution the pulse had dropped to 96, with a good volume. The blood-pressure had dropped to 138/80. All accumulation of bronchial secretion had disappeared, and there was but little cyanosis left.

During the remainder of the second day the patient was unconscious, though not deeply comatose. She also tended to become restless. A second high colonic lavage was given in the morning and was returned slightly coloured ; but the first motion since admission occurred in the afternoon. Potassium bromide was given rectally to control restlessness. Four-hourly rectal salines and two-hourly hypodermic injections of coramine were also given.

On the third day the patient was on the border line of consciousness, i.e. could be roused. All treatment was stopped except a third high colonic

lavage which this time brought away accumulations of fæces and undigested matter. As rectal salines were not being retained, nasal feeding was instituted.

On the fourth day the patient recovered consciousness and was able to take food by the mouth. She had been unconscious over sixty-four hours.

On the fifth day, the breasts showing normal activity, she began to feed her baby.

On the seventh day albumin had disappeared from the urine. Proteins were added to the diet and the patient was considered out of danger.

On the tenth day she was allowed up, and on the fourteenth day she was discharged from hospital in a normal state of health, her baby having gained six ounces in weight.

In conclusion, there are some points of interest which seem to emerge from this case :—

(1) In view of the much discussed ætiology of eclampsia, it seems probable in this case that an intoxication of intestinal origin played its part. The bowels had been inactive two days before the onset of labour and were only properly relieved forty hours later, after the third high colonic lavage.

(2) Albuminuria need not precede the fits ; it only manifested itself later in this case and in comparatively small amounts.

(3) The usual measures in the treatment failed to arrest the course of the disease, or even to control the fits in any way. Though it is realized that abatement of symptoms and cessation of fits does sometimes occur, irrespective of the forms of treatment adopted, it is to be noted that lumbar puncture was followed by two more fits only, and that these were of a comparatively mild and fleeting nature. This result is attributed to the relief of intrathecal and intracranial pressures, and therefore lumbar puncture is suggested as a measure worth considering.

(4) One cannot help wondering whether morphia is the sedative of choice in such cases, as it tends to enhance such unfavourable symptoms as shallow breathing, coma, cyanosis, and pulmonary œdema.

(5) This case also illustrates the benefits derived from oxygen and carbon dioxide inhalations in a case showing signs of shock, cyanosis and pulmonary œdema.

The carbon dioxide not only improved the action of the respiratory and cardiac pumps, but it also lessened the coma and assisted the patient to rid herself of fluids accumulated in the bronchial tree. It lessened acidosis and improved oxygenation.

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ON THE RELATIONSHIP BETWEEN VARICELLA AND  
HERPES ZOSTER.

BY MAJOR I. H. LLOYD-WILLIAMS, M.C.  
*Royal Army Medical Corps (T.A.).*

FOR a long time it has been noted that there is a clinical relationship between shingles and chicken-pox, as is instanced in dermatological textbooks and recurring correspondence in the medical journals.

The following cases from my own experience are typical examples:—

*Case 1.*—A man, aged 65, developed a typical herpes zoster of the first and second sacral nerves on the left side affecting the buttock, back of the thigh and left side of the scrotum and penis.

Fifteen days after the appearance of this rash his grandson, who lived in the same house, developed chicken-pox. The grandfather gives no history as regards a previous attack of varicella in himself.

*Case 2.*—A somewhat similar sequence occurred in my practice about twelve years ago. In this case the child developed chicken-pox, and her mother who was nursing her in due course developed herpes zoster.

Both diseases are admitted to be virus infections. I am aware how far there is laboratory proof of the identity of the two viruses.

In a recently published paper, a definite antibody has been demonstrated in herpes. The titre of this can be raised in a certain number of cases, though this would not invariably appear to be successful.

In some patients recurring attacks of herpes are seen even in the presence of antibodies. It is suggested that these cases are carriers. It also appears that recurrence is apt to occur when the antibody content of the blood has fallen below a certain level; this is particularly likely to occur when there is a second infection, such as pneumonia or a cold.

Herpes labialis is the more usual form to recur; herpes zoster rarely does. The slight warnings of onset in the latter are often unappreciated by the patient until the eruption occurs. It is then too late to consider prophylaxis.

The occurrence of both diseases in the same subject, but at different times, is rare. I have only known it in one case, and that was myself. I had varicella as a child, and about ten years later herpes zoster while at school. In the latter case, so far as I can remember, I was in good health and there were no similar cases at the time.

It seems that the chief point for solution is the identity of the two viruses. They may be completely separate organisms, or possibly different strains of the same virus. If the latter, there may be an analogy between it and the *Spirochæta pallida*, where different strains tend to produce in the tertiary stage either gummatous conditions or neuro-syphilis. Variations in the patient's resistance might play a deciding part as to whether a generalized infection, i.e. varicella, or a localized one, i.e. herpes, occurred.

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## Travel.

### INDIAN JOURNEY—INTERRUPTED.

BY "UNST."

JUBBULPORE in the Central Provinces of India is a pleasant station. I had been posted there from Belgaum in the south in September of the year 1930, and did not take long to settle in my new environment. I had already made acquaintance with the small game shooting, which was excellent, though not a shade better than I had previously enjoyed in Belgaum, and I was looking forward eagerly to getting on terms with big game in the famous jungles which need no description. I was also searching for a mount, "up to any weight," which might carry an indifferent horseman over the Nerbudda Vale country. I was in a mood of contented and pleasurable anticipation when my plans were suddenly modified by the exigencies of the Service. To put it less elaborately, I had been in Jubbulpore for about one month when I was ordered to Peshawar, to proceed there, as the pundits say, "forthwith."

I was not unduly troubled by this upheaval. The frontier was new to me, and I longed to see it. My old bearer, a rapid and seasoned packer, was utterly phlegmatic about moves. Last, but not least, I had just bought a new car, a six-cylinder Chevrolet tourer in rather loud taste, with a blue body and wheels of a sickly yellow. As far as this vehicle was concerned, my transfer to Peshawar was a good thing, as I wished not only to see what the car could do on a long run, but also to remove it from the station before the remarks of my friends about this very car caused me to commit homicide. I forwarded my heavy baggage by rail, and, early one morning, carrying as little kit as possible, and accompanied by my bearer and a cocker spaniel, I started on the fourteen-hundred-mile drive to the North-West Frontier.

Motoring in India is a pleasant and eventful pastime, very unlike the orderly and comfortable progress one experiences at home. To digress a moment, I remember on one occasion motoring along a jungle road in South Kanara with a friend. It was twilight, and the darkness increased as we entered a defile caused by high banks of red earth flanking the road. Something ahead caused my friend, who was driving, to stop, and he called my attention to an object about fifty yards ahead, which I took to be a bundle of leaves.

"It's a panther," he said.

I replied in suitable terms, stressing my unbelief, so we decided to put the matter to the test by leaving the car and approaching the object under discussion on foot. We had not gone twenty yards before I discovered that my friend was right. It was a panther, and, disliking our propinquity,

it made off, clearing the twenty-foot bank with a nonchalant spring and scramble. On another occasion I have come face to face, or rather face to radiator, with a large bull bison, and I have listened to a harrowing story, related by a Gunner colonel, of a sambhar stag which leapt into the back of his car, attracted, so he said, by a case of beer. As he was telling this story in the bar, at his expense, I listened to the bitter end, or shall we say the gin-and-bitter end. Two friends of mine, driving from Peshawar to Risalpur after a dance, were stopped on the road by a barricade of bullock carts, and, on alighting to go further into the matter, were held up by bandits and politely but firmly dispossessed of all their worldly goods. As this digression, starting as an inlet, threatens to become a veritable arm of the sea, we will drop it.

I started, then, from Jubbulpore in the early morning. My first stop was Damoh, where a tendency on the part of the radiator cap to emit steam indicated a shortage of water. I needed no petrol, so I drove to the nearest water visible, a pump in the middle of a cobbled maidan, got out to stretch my legs, and left the whole proceedings in charge of my bearer. When I returned, after a brief sight-seeing tour, I expected to find the car ready, but such was not the case. The car was not to be seen, but I presumed that it was somewhere in the centre of a large and variegated crowd which had collected round the pump.

As unobtrusively as I could, I worked my way through the crowd to my car and found a strange scene being enacted. My bearer, on being ordered to fill up the radiator with water, had delegated the duty to a third person, in the time-honoured manner of the old soldier, to which "genre" he certainly belonged. The man who had volunteered for this job was without doubt a simpleton. He poured the water carefully, in the manner of one decanting liqueurs, and was mystified and chagrined to find that there was no end to his work, because the rate of his pouring was negated by the escape of water down the overflow pipe. Some onlooker of malicious disposition had told him that the overflow pipe led, not to the outer world but to the vitals of the car, and that gallons of water would be required before the flow down the pipe ceased. He also added that if the work were not finished before the sahib came back, the sahib would be very, very angry.

Consequently I arrived to find this wretched water pourer in a state of abject fear and intense perspiration, the butt of a large crowd, not excluding my bearer, who had purchased a bottle of lemonade, and was enjoying the situation over a quiet drink.

The whole plot was exposed to me by a superior young man in a pagri and plus fours, and I put an end to the entertainment, presenting the village idiot, who was very put about, and obviously expected a buffet, with a rupee. I roundly upbraided my bearer for tolerating such nonsense, explaining to him that I expected more from a man of his age, experience and military service. The old man was rather ashamed of himself,

and could not account for this lapse from his usual Jeeves-like impeccability.

I think a word about him here would be in place. He accompanied Younghusband to Tibet in 1902, and wears the rare medal of that expedition. He served in the Mohmand rebellion in 1908, and was awarded the Indian General Service Medal. He accompanied the 41st Dogras to France, which entitled him to the 1915 Star, the British War Medal and the Victory Medal. He gained a clasp to his Indian General Service Medal when he served with me on the Kajuri Plain in 1930, and he accompanied me on the Chitral Relief in 1932, again active service. Through all these wars and tribulations, he carried out the duties of an officer's bearer. During his sojourn in France he was shot through the knee. This old wound, though honourable, was inclined to arise in conversation on the approach of hard work. He is one of the old types of Indian bearer, and I can say without hesitation that I have never met a more perfect gentleman. It is a long time since I have been to India, but if I never go there again I shall never forget him. He has retired from work now, and lives in his village. I wish him a happy old age.

Leaving Damoh behind, my next stop was the dak bungalow at Malthone. I had pleasant memories of this spot, having spent a short shooting leave there the previous year, and decided to stay for a protracted tea meal, my lunch having consisted of a few perfunctory mouthfuls at the steering wheel. While my bearer was collecting the necessary materials for the repast, I picked up a shotgun and crossed the road into the adjacent scrub jungle, having memories, from my previous visit, of game not a stone's throw from the bungalow verandah. I was not disappointed, and returned in less than an hour with a brace and a half of black partridge. After consuming, in a leisurely fashion, a noble meal of strong tea, eggs and bread, I drove onwards to Saugor. One year before I had been stationed at the Indian Cavalry School, and I could not believe that all my friends had left it, quickly as stations change and acquaintances fade in India. There was no course in progress, but the staff remained, unaltered since I had known them before, and I was very hospitably entertained, even to the point of wondering whether or not I should get any sleep to fortify me for a long drive next day.

I departed early in the morning. At breakfast I had been obliged to choose between champagne and coffee, but succeeded in avoiding the former. The road between Saugor and Jhansi passes through delightful country. Everywhere is the jungle, not close and forbidding as in the south, but open and variegated, alternating with rolling plain and broad cultivation, at one point overwhelming the traveller, shutting out the view, and then yielding to a vista of wide, undulating country only limited by the dim blue of a distant horizon. The drive to Jhansi was uneventful except for one incident, temporarily distressing and typically oriental, which occurred at the crossing of the Betwa, a river intersecting the Saugor-

Jhansi road. Communication between the two banks of the river is maintained, during normal times, by a wooden ferry boat, antiquated, but sufficiently large to transport motor vehicles of any size. When the river is low, the ferry is out of commission, owing to the appearance of large stretches of soft sand on either bank, impassable to motor transport. At such times, drivers of automobiles are obliged to have their cars and themselves bodily hauled across by coolie, rope and bullock train. When I arrived on the southern bank of the Betwa, the river was low.

It was early afternoon, and the immediate neighbourhood was singularly deserted. On the ferry boat, which appeared to be grounded on the near bank, slouched a nondescript individual who might have been dead, but who turned out to be merely asleep, and eventually awoke on being gently prodded with a walking stick, this method of persuasion having over-ruled my bearer's suggestion of pelting him with stones. Awake, he was either deaf or feigned that affliction, remaining quite unmoved by our questions, exhortations and threats. He was not blind, however, and he produced, from some recess in his unbelievable garments, a vernacular newspaper which he proceeded calmly to read.

A deadlock had arrived. Reluctance to commit homicide debarred me from any solution, but the impasse was surmounted by my bearer. Lowering his voice several octaves, he began to speak, quietly and intermittently, to this man. What he said I do not know, but the effect was immediate. Charon, Youth at the Prow, or Pleasure at the Helm, call him what you will, leapt in the air like an animated scarecrow and disappeared eastwards in a cloud of dust and a rapidly diminishing smell. I was blankly astonished.

"What did you say to him?" I asked my bearer.

"Sahib," he replied, indulgently, "I asked him to fetch men and byles, and he has gone to fetch them."

One should never ask unnecessary questions of old soldiers.

Whatever the nature of the boatman's quest may have been, he certainly dragged it out. I lit a pipe, and, disliking inactivity in that slumbrous atmosphere, set off on a voyage of exploration along the river bank, in the opposite direction to which the boatman had fled, bidding my bearer recall me with view halloa when reinforcements arrived. The sand near the river was firm. The day was hot and still. The sun saturated the afternoon air and all the landscape. I had that vague and rather uncomfortable impression of limitless and purposeless distance that sometimes assails one in the Plains, when I was jerked back to reality by an awful hubbub arising from the place I had just left. I turned about and saw my bearer and car surrounded by an assortment of human beings and bullocks. The human beings were agitated. The byles were stolid. My bearer was minatory. Even at that distance I could recognize an attitude of aggression in his old but sturdy frame. The air was rent with imprecations. The price war was on.

I returned, rather more quickly than I had set out, to find the old man on the verge of tears.

"Sahib," he said, "these ——— want thirty rupees." Then *sotto voce* : "Offer them thirty and then give them nothing once we get across."

My bearer, had he not missed both vocations, might have gone far in politics or big business. Like all great ideas, his was the essence of simplicity, but I could hardly accept it, and settled down to bargain. The spokesman of the relief party—which looked as if it had been indiscriminately selected from the nearest jail—was a Brahmin, wearing the triple thread of his caste, and a very superior person. He waved aside my Roman Urdu and overwhelmed me in the most appalling deluge of babu English I have ever heard. I believe my bearer would have cheerfully murdered him. The argument was long and fruitless, but a lucky idea enabled me to produce a trump card.

"Very well, then," I said, "I now go back to Saugor and put all this in the hands of the police."

This suggestion visibly rattled the twice (or is it thrice?) born.

"My good sir," he expostulated, "we are all good men out to help, naturally" (or words to that effect), "we will do you for twenty."

"Ten."

"Fifteen."

"Twelve."

"Right-ho, sir, the bargain is then consummated."

And, while my bearer gnashed his teeth in impotent rage, lengths of stout rope were produced, bullocks were efficiently yoked, and my car was triumphantly towed to the far bank. Here the Brahmin, who seemed to be the treasurer as well as the spokesman of this Third International, accepted twelve rupees with hauteur. I pressed the starter and set on my way with a feeling of freedom and relief. I had gone several miles when a wail, like the ultimate shriek of agony from a lost soul, nearly caused me to wreck the car, and certainly made me stop it. This awful ululation proceeded from my bearer, who, in an unusual and certainly undignified posture, was leaning over the back of the car. I dismounted, hurried round to investigate, and then I saw it all. My own scant luggage was disposed inside the car. His, even scantier, was roped on the luggage carrier. All that now remained of his total worldly possessions was represented by a few ends of rope, obviously cut with a sharp knife. The Third International, after towing us across the river, had, while their Brahmin chief was accepting fees and indulging in conversation, extracted extra forfeit by removing my bearer's bundle of possessions from the luggage grid.

It was too much for me. The whole comedy, starting with the human scarecrow on the ferry boat, leading up to the motley crowd of men and animals haranguing on the bank, the flatulently discursive Brahmin, the procession, like a Roman triumph gone wrong, across the fallen waters of

the Betwa, culminating in the petty theft of a few blankets, trinkets and kettles, struck me like a club. I started to laugh and could not stop. The laughter fed on itself and soon I could no longer stand. I sat shamelessly on the road, my back against an ample mile stone, and roared and howled, while my old bearer regarded me reproachfully. I don't think he has ever forgiven me. He was still reproachful when, weak and hiccoughing, I crawled limply into the car and set it in motion for Jhansi. Long live the East!

I arrived in Jhansi after dark, found the dak bungalow, bathed, consumed a belated sundowner, ate a satisfying meal and turned in.

I awoke before dawn considerably refreshed. My bearer brought me tea and his whole countenance was lit as with a lamp. I asked the reason of his inordinate joy and he told me that his missing baggage had been brought to the dak bungalow half an hour ago in a car, by a sahib who had seen the bundle on the road with his headlights, and had retrieved it. Who was the sahib? He did not know, but he was an Indian, not an Englishman. Did he stay? No, he passed straight on. What was the number of the car? Not taken. I have given up trying to solve the problem of my bearer's luggage. The ropes were obviously cut and the abrupt reappearance of the stolen booty in the small hours was puzzling, to say the least of it. Anyhow, what does it matter?

We bowled along the ever-improving road in the direction of Gwalior. At one point during the journey I was puzzled by the presence of large coveys of partridge flanking the road. On the approach of the car they did not fly, and indeed appeared unwilling to move at all, one or two coveys running along in a middle-aged manner. I slowed up. This did not worry the game. A few yards further on the presence of several peafowl determined my action. I stopped altogether and started manoeuvring for my shotgun. If even then these amazing birds refused to fly, I could always salve my conscience by "shooting for the pot." I had even loaded, but my hand was stayed in the last instance by the thought that I must be in some game preserve, so very reluctantly, to the wrath and almost the mutiny of my bearer, I unloaded and started off. Some hundreds of yards further on the problem was solved by a signboard on the right of the road—"Datia State. All shooting prohibited." The rulers of Datia are Jains and do not take life, so all game is safe and tame in the sanctuary of their State. I have heard of travellers on this road who have unwittingly, and even wittingly, violated the Jain law in a Jain State, but I am glad to say I refrained, although I came very near the mark. In this region the monotony of the landscape which had deteriorated and recently touched low water-mark in a series of arid and distorted gorges crowned by grisly underfeatures resembling the tortured shapes of the foothills near Jericho and the Dead Sea, was relieved by a fine ridge crowned with a remote and magnificent castle.

"The glamour of the East" is a hackneyed term, hackneyed because

that same glamour is hidden to the great majority of Westerners who cross the Suez Canal, more hidden because it does not exercise its fascination until the traveller has stepped ashore on the Indian peninsula. Not in Egypt, with its cosmopolitan cities and vast stored archæological wealth, not in Sinai, even with its Crusaders road, not in Palestine, of biblical memory and eternal racial hatred, beats the vital and romantic pulse of the East, but in India, the land of great jungles and deserted temples, of sorrow and despair and short-lived joy, of living martyrdom and ascetism ; the land of hushed beaches and unknown gods, of teeming death-infested cities, and the magnificent, far-flung, eternal snows of the Himalaya. Here is the East.

To know it is to suffer. Its knowledge is bought, if not by blood, by hard experience. Kipling, in "The Naulhaka," threw aside the veil. Yeats-Brown, in "Bengal Lancer," probed a secret. His descriptions of Benares and the Taj Mahal are vivid and alive. Aitchison, newly come to India, grasped a truth in his book "Hindu Holiday." He showed us the very ugliness of India's beauty.

Here, as I drove along in the late afternoon, in the shadow of that grim castle, I felt the glamour that is always hidden, but shines forth at times in the lines of great writers and the mind of travellers who are willing occasionally to leave cantonments and railway trains. Who lived in that immense pile? What scenes had been enacted within its walls since it had been built in the dark ages? Its grim bastions, frowning from insurmountable glacis and ridge, breathed the very spirit of India, the India of Clive and the Mahrattas, of Tantia Topi and the Mutiny, of all the dark sorrow and intrigue and mystery which have shaken the inscrutable peninsula since the dawn of time.

My romantic and somewhat sombre mood was shaken back to normal by a comic interlude. A long drive, lined by trees, led from the outworks of the fortress to the road, and at the junction of road and drive stood a solitary, uniformed, bearded and venerable sentry. Despite his extreme age and rather rusty movements, his authority was not to be gainsaid, for he advanced into the exact centre of the highway. There was no way round him so I stopped the car and got out. Every single accoutrement of that ancient "mariner" was upside down. His shouldered rifle was held by the muzzle. His pagri badge, his shoulder numerals and his belt buckle were all standing on their heads. He had no buttons on his tunic, nor had he requisitioned the services of the dhobi for some considerable time. He looked like a demented boy scout out of Alice in Wonderland.

In reply to his challenge, voiced in an unknown tongue, I explained, in my best company office Urdu, the deficiencies of his uniform. He was unperturbed but answered me in Urdu of a remarkably pure strain. If his uniform were wrong, would I put it right? I delegated these duties to my bearer, who performed them quickly and efficiently, roundly upbraiding the soldier, as one respectable old man to another, for his untidiness. The

sentry, renovated, salaamed, gave thanks, stepped back to his post near and almost in a cactus bush, and we continued on our way.

When we reached the environs of Gwalior it was dark. I was making for an hotel I knew, and the journey here was relieved by two singular incidents, one pleasant and exciting, the other exciting if definitely the reverse of pleasant.

The first incident occurred on a lonely, jungle-flanked road some considerable distance from the city. I was driving in the dark, with my headlights fully on, when suddenly a panther flashed across the road, a dark, lithe streak in the glare of the lamps. The panther, instead of vanishing like a wraith into the welcoming jungle, turned squarely and sat on its haunches in full view at the edge of the metalled road. Simultaneously I braked and stopped the car. The panther sat there unconcernedly like a tabby cat on the hearth, in the hard glare of the lights, looking, not at the halted car, but straight across the road. I followed the animal's gaze and suddenly on the other side of the track, catapulted from the dark jungle like stones from a sling, shot two diminutive but very speedy cubs. They joined mother and the trio made off, this time with no perceptible delay. If the maternally-minded panther had decided to attack us in the car she would have made mincemeat of both my bearer and myself as I had no loaded firearm handy. I was foolish to stop the car but I saw something of interest. Anyhow, I got away with it.

The second incident occurred very much nearer Gwalior. I was driving along, wondering whether if I had a rifle or shotgun (at that range) handy, I should have resisted the temptation to put that panther in the bag. (I say resisted the temptation, for although at that time it was permissible to shoot panther, looked on as vermin, from cars, I always held strong views on the subject, considering such procedure unfair. A panther, enticed from the jungle by the purr of an automobile engine, blinded by headlights, is hardly a sportsman's mark. I notice with satisfaction that the Forest Officers of India have recently taken up a similar attitude, and game laws have been revised to prohibit slaying big game of any description from the comfortable upholstery of a motor car.) As I was mooning along, another car hove in sight, coming in the opposite direction, with blindingly strong headlights. I dimmed my lights, but the other driver kept his full on, so I tilted mine back again. Enraged by such unreasonable procedure, my opposite number then turned on a spotlight in the neighbourhood of his windscreen and flashed it full in my face. This completely blinded me, and I was compelled to draw into the side and stop dead, hoping fervently not to meet a tree on the way. My car came to a standstill. The approaching headlights loomed closer, I heard one terrific report, and a charge of birdshot, No. 6, I should guess, came whistling around my ears. Providentially none of it hit me. Fired from the side and slightly in front, most of the charge had been taken on the off side of the Triplex windscreen. I was concerned for my bearer, but needlessly. He was unscathed, and



the dog also had escaped scot free. I was a bit shaken by this exhibition of perfect road manners on the part of some unknown, but I managed to reach the hotel and restored tissues in the usual manner. My bearer picked some pellets from his pagri, and confirmed my diagnosis. It was No. 6 shot all right.

Next day we set out for Agra: one more river to cross! The broad waters of the Chambal, however, were sufficiently high to allow the ferry to function unhindered. I checkmated an attempt on the part of my bearer, who had commandeered a receipt in advance in true Oriental style, to decamp without paying toll, and drove on smoothly, without mishap, to Agra. Here I received my first real set-back. I drew up at a garage to replenish the vital needs of the car, and was accosted by a rather seedy looking Indian gentleman in a smart store suiting. He asked me who I was, and I told him unconcernedly enough.

"Ah," he replied, "the Provost Sergeant is looking for you."

I cast my mind back over my recent misdeeds, but was unable to recollect any encroachment on the Army Act.

"What does he want?" I inquired.

"You have to go back to Jubbulpore."

Here was a pretty kettle of fish. I set out to confirm this scandalous news, but the day being Sunday, and my topographical knowledge of Agra confined to the whereabouts of the Taj Mahal, I had some difficulty in unearthing the authorities. Eventually I discovered the Staff Captain, *non sine pulvere*, consuming a cool drink on a handsome verandah.

"Oh, yes," said that potentate calmly, in answer to my frantic inquiries, "back you go to Jubbulpore. Your move is cancelled. Have a drink."

There was nothing for it but to retrace my steps, or rather wheel tracks. I was disconsolately threading my way through the Agra traffic, already starting the return journey, when a large figure, dressed to the minute in some sort of a silk suit, leapt in front of the car, endangering his worthless life, and emitted a roar of welcome. It turned out to be a friend of mine, a subaltern in the Royal Irish Fusiliers. I poured my tale of woe into his ears, and he shrieked with laughter. He asked me where I was going, and I told him, back to Jubbulpore. He said, No, I wasn't, I was coming to stay in their Mess for an indefinite period of time, to be determined by him. I demurred, with some language, but by this time he had been joined by some of his friends, who, after perfunctory introductions and explanations, agreed unanimously and forcibly that I should stay. When I still demurred, they merely dispossessed me of the wheel and drove to the club, my bearer perched precariously somewhere in the region of the luggage carrier.

I spent a pleasant day or two in Agra, revisiting, in the mornings, the world-renowned beauties of the place, seeing the Taj Mahal from where it should be seen, from the far bank of the Jumna, and when it should be seen, at sunrise, at the time and from the place that Shah Jehan, helpless

and dying, was raised to see for the last time, with his last breath, the majestic splendour he had created out of his own mind. In the afternoons I played squash racquets, and spent the evenings in the club. When at last I was afraid my military career would be blasted by any further delay, I tore myself away. I stayed not upon the order of my going, but went, with my flat foot on the floor and my eyes glued to the road. Errant partridges, magnificent views to reward my camera, flashed by unnoticed. I locked up my gun and camera and saw nothing but the road, the road, the road. I flew.

Approaching the Chambal Ferry, I hit something which looked like, and was, an itinerant water tank on wheels. This dented the car somewhat and reduced my bearer to tears, but the vehicle still went, so what odds. The Betwa River was still low, but I collected the haulage gang in record time (I think they sensed I was ripe for murder) and brooked little delay there. At Malthone I was ejected from the dak bungalow by a pack (or is it covey?) of hysterical female missionaries, who could not abide a man under the same roof, but I turned out my camp bed and slept on that, rising long before dawn to start in complete darkness and scorch up the miles under the glare of headlights.

I cannot remember, but I am firmly convinced I did not draw breath until I arrived in Jubbulpore. I will not set forth here the time I took to traverse the distance between Agra and Jubbulpore, because nobody would believe it if I did. Suffice to say that, still in a state of considerable tension, I off-loaded in the gardens of the Nerbudda Club and went in search of my Commanding Officer. It was the time of the afternoon siesta, but I should worry, as they say in America. I found him lying in bed, having an early afternoon tea. My cocker leapt through the window and was rewarded with toast.

"I suppose you heard, sir," I ventured, "my move has been cancelled?"

"Yes," he replied, salving with difficulty the last of the toast for his personal use, "I heard that, and more. Your move's on again. You're going back to Peshawar."

I turned and ran. I heard some agitated shouting, which, I suspected emanated from my Commanding Officer, but, I regret to say, I took no notice. This time, I determined, I would damned well go to Peshawar. Doubtful civilians inquiring sheepishly after my identity would be shot at sight. Provost serjeants, staff officers, and others approaching with official documents would be struck down with the starting handle. If I were cornered I would say I was Jack Dillinger, General Booth, or the prophet Isaiah. I would do all these things and more, but I was determined that nothing would on this occasion divert me from the capital of the north-west, so remote and apparently so difficult of access.

I spent the night once more at the dak bungalow of Malthone, undisturbed by missionaries, male or female. A curious peace had descended upon me. If I were fated to spend the rest of my life caravanning the

long roads of the Indian peninsula I would at least enjoy myself. I wandered into the country with a shotgun, but was soon jerked out of my somnolence by an outstanding number of black partridge. I enjoyed stupendous luck and bagged four brace in under an hour. I was hard put to carry them as I had come unprepared for such a spate of birds, but I solved the problem by improvising a game carrier from a handkerchief torn into strips.

The Fates, having touched me up a bit, were inclined to be lenient. The journey proceeded smoothly without major catastrophe. The Betwa chain gang were actually waiting for me ; perhaps their Brahmin chief had telepathic powers and sensed my coming. The Chambal was crossed without further damage to the car, but I was electrified by the sight of a very crazy raft, shockingly overloaded with coolies and tilted at an impossible slant, being propelled across the river in primitive fashion by oarsmen who had every appearance of being inebriated. The raft was closely followed by a shoal of at least twenty gharial. The gharial is a gentleman and eats only fish, but those gharial in the Chambal looked capable of anything.

My bearer was wildly excited as we approached Delhi. He had not seen it, he said, since he was a small boy, which must have been a very long time ago. Also, he added, "Delhi ke samne, Agra mamooli jagar hai," which being translated means, "Compared with Delhi, Agra is a one-horse show," or something like that. Magnificent towns, with historic associations long buried in the past, have ceased to mean so much to me. They could keep Agra and Delhi. I wanted to see Peshawar.

We left Delhi at four o'clock in the morning. I was feverishly restless again and obsessed with the idea of speed. The Grand Trunk Road lay in front of me, straight as an arrow, smooth as a windless lake in the sun. There was no doubt about it, I was going too fast. I was certainly doing sixty-five when the near front tyre burst. The car swerved, lurched sickeningly, and turned upside down in the fraction of a second. The transition from upright to upside down must have happened in an infinitesimal moment of time, because I have no recollection of it.

Of every other incident of what must have been one of the most extraordinary motoring accidents on record, I have the clearest remembrance. The first thought that passed through my mind was that I was neither brained nor stunned, but perfectly conscious. Why, I wondered? Let's find a reason. Let's be logical if nothing else. I was wearing a thick pig-sticking Cawnpore topi which had hit the tarmac with a resounding thump, and undoubtedly saved my life. The rim of the topi was pressing uncomfortably on the bridge of my nose, but I decided not to grumble about that under the circumstances. I tried to shout for my bearer, but could not. Temporary aphonia was the only injury I suffered in that appalling smash. Then my brain, working independently, struck off to solve another problem. The car, being a tourer, should have had the hood driven in by the impact, and be flush with the ground. What had kept the hood up? Then I

remembered that my bearer had been in a hurry that morning and had jammed the luggage into the back seat haphazardly and anyhow, roof high. The luggage, so untidily bundled into the car, had saved my life. I wondered about my bearer, but I couldn't speak : still that blasted aphonia. I moved my arms and my hands, which were on the steering wheel, and my feet, still on the controls. My limbs were intact. My brain took over control again. I must get out. I willed to move, but something had gone wrong with the connexions. Suddenly the wrecked car gave an ominous creak and subsided a little. My head was driven into the road and the pressure of the topi on my face became intolerable and suffocating. I suddenly got the full power of my limbs and struggled as only a trapped and suffocating man can struggle. I still had sufficient strength left not to make my efforts entirely aimless, and concentrated on escaping through the framework at the side of the hood. It seemed that failure would be my only reward. I became breathless, light-headed, and for one agonizing moment was racked with cramp. God was good to me, however, that day, and one last despairing effort (if that had failed I think I had played my last card) thrust my head between the struts of the hood. I rested a little and got one arm out. Then I managed to free myself from the blinding caress of the battered topi. I got out my other arm—not so easy this time. Another short rest, a heave, a wriggle, a pull, and I was free. I stood up weak and sweating, and regarded the wreck of the car with mixed feelings.

I shouted my bearer's name and got a feeble reply. He was alive. I shut out the thought that I might find him horribly crippled and attempted to disentangle him from the wreckage. I might as well have tried to uproot the Great Pyramid of Cheops. I could not reach him, nor could I budge the wrecked car an inch. Worse still, the car was sinking gradually. It subsided until, with a nerve-racking blare, the horn button on the top of the steering column hit the road, and the quiet morning air was filled with a hideous and continual hoot. This was another benison of God. The appalling noise attracted a band of Sikh ryots who were two fields away from the road, hidden from view by a hedge, and proceeding, until they heard that awful din, in the opposite direction to the car.

I blessed those merry, chattering Punjaub Sikhs. They swarmed round the car like ants round a jampot, and in less time than it takes to describe the act with pen and ink, had the car on its side. Then I drew breath again. All my troubles were dissolved. My bearer, still wearing his pagri, stepped forth unharmed from the wreckage, followed by my cocker, who regarded the whole incident as a huge joke, and obviously, from the gleeful way he wagged his tail, desired a repeat performance. My bearer, had, unfortunately, sustained a few minor abrasions and a fractured metacarpal, but he made light of these injuries and started to exhort the Sikhs who told him to shut up. One of them politely suggested that if he would not help, he might at least find his master a drink !

I never saw anybody get their teeth into a job of work like those Sikhs.

Their next effort was to put the car on an even keel and review the damage, which was considerable. The whole superstructure of the car was match-wood. One door had been torn off bodily, and the bonnet looked as if it been battered by an infuriated blacksmith wielding a sledge. The Sikhs changed the wheel—the tyre and tube had been ripped and slashed to ribbons—threw the errant door into the back seat, produced lengths of rope from apparently nowhere and made fast the shattered hood.

“Now, sahib,” said one of them, grinning all over his broad face, “get in and drive off.”

I wedged myself into the salvage and pressed the starter with no hope. The engine started up. I threw in the gear and let out the clutch. The car moved forward as if nothing had happened. I stopped the car, left the engine running, and offered generous largesse, which was promptly refused with some show of anger. I thanked my deliverers as best I could, shook hands all round, saw from an adjacent milestone I was nine miles from Jullundur, and set off. When I arrived in Jullundur I made the British Military Hospital my first port of call and had my bearer's injuries dressed and splinted. I then drove the awful wreckage to a garage, told them to do what they could, deliver the car in Peshawar at a subsequent date, find me a taxi and deposit me at the railway station. Arrived there, I purchased tickets for Peshawar and spent the rest of the day enjoying the very welcome hospitality of a combined medical and sapper mess in Jullundur.

I slept that night on the Frontier Mail and awoke in the wild country round Attock. Soon I was in Peshawar, reporting to a harassed Commanding Officer. Who was I? What did I want? Why had I come? He had heard nothing of it. There was no job for me to do. He had too many officers. I ventured a mild suggestion.

“Shall I go back to Jubbulpore, sir?”

What the hell did I mean? Was I trying to pull his leg? Happy thought. He would send me to the Kajuri Plain. I asked nothing better, and there I went.

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## Current Literature.

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ADEY, C. W., and PATTERSON, R. W. **A Diluent for Diphtheritic Toxin for Schick's Test.** *M. J. Australia*. 1937, v. 2, 248-51. [14 refs.]

The following diluent was found to be satisfactory for stabilizing Schick solutions. Boric acid 8·4 grammes, NaCl 15·9 grammes, borax 5·7 grammes, purified gelatin 5·0 grammes, distilled water 2 litres. This is a modification of Kusama and Hata's diluent [*Bulletin of Hygiene*, 1934, v. 9, 766]. This mixture generally has a pH of 8·0. Sterilization is effected by autoclaving at 115°C. Sodium ethylmercurithiosalicylate is added as a preservative to a concentration of 0·01 per cent. The gelatin must be purified and detailed instructions for its purification are given. Schick toxin diluted with the

solution could be preserved for 298 days at 2° C., and in general resisted 37° C. for six days without appreciable loss. Experiments are also mentioned in which the diluted toxin was kept at room temperature during the summer in Melbourne (30° to 40° C.) for thirty days without loss—beyond this period it was found to lose potency. [This paper is from the Commonwealth Serum Laboratories.] C. C. OKELL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 1.*

KAISER, M., and HASSMANN, K. Praktische und klinische Beobachtungen über die subkutane Pockenschutzimpfung. [Practical and Clinical Observations on Subcutaneous Vaccination.] *Arch. f. Kinderheilk.* 1937, v. 112, 40-59, 2 figs. [40 refs.]

Inspired by the successful results obtained by Gallardo in Madrid and Hydetake Yaoi in Japan, the authors performed about 500 subcutaneous vaccinations, some in different places in the Burgerland Province and Lower Austria and some in Vienna. The lymph used was either the diluted form which had been kept in a frozen state or the standardized dry lymph. The results were such as to invite a further trial, but no conclusions were reached as to the duration of the immunity conferred by this method. Although both the general and local reactions varied in different cases, as a general rule they were not severe. The most striking features of the new method were the complete absence of vesicular or pustular eruptions and the simplicity of the technique.

The method is specially suitable for poorly vaccinated countries, where it is welcomed owing to the absence of eruption and other vaccinal lesions. J. D. ROLLESTON.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 1.*

FELKE, H. Die Chemotherapie der Gonorrhoe. [The Chemotherapy of Gonorrhœa.] *Deut. Med. Woch.* 1937, v. 63, 1393-5.

Felke refers to Grütz's report to a medical meeting on certain experimental preparations made by I. G. Farbenindustrie-Elberfeld which, without local treatment, had cleared up a number of cases of gonorrhœa very rapidly. At the same meeting Felke had reported good results with one of the preparations in question, DB 90, which appears to be in the same chemical group as prontosil. As a preliminary to a further report on results of treatment with one of these preparations he emphasizes the importance in gonorrhœa of the development of an immunity, and mentions that in many cases an attack of epididymitis, no doubt by strongly provoking this resistance, has brought a gonorrhœa rapidly to an end. The case is different with gonorrhœal salpingitis, which seems strongly to prejudice recovery. The author thinks this is due to the ability of the gonococcus to persist in the tubes, as he has shown culturally in seven out of twenty preparations of the uterus with gonorrhœal adnexa which he obtained by

operation. These remarks by the author are to support his contention that the *vis medicatrix naturæ* is a very important factor in the cure of gonorrhœa. With regard to internal medication, he does not think urinary antiseptics the right remedies and admits that, when prontosil first appeared, he regarded it as merely a particularly effective medicament of this kind, but was not greatly impressed by its effect on the general course of gonorrhœa. He then received a supply of a new experimental preparation of the prontosil type, namely DB 90. This has proved a true specific for gonorrhœa. Without other treatment, when given orally DB 90 quickly cleared up gonorrhœa in men, women and children provided that the stage of readiness to heal had been reached. In other cases it was the strongest adjuvant he had ever used. Out-and-out failures were very rare, and, in his opinion, explicable by some biological failure of the organism. He gives particulars of his experience of fifty cases of gonorrhœa treated with DB 90. Early gonorrhœa in men was not aborted by the remedy given in doses of 5 grammes daily; the urine remained clear but gonococci did not disappear. On the other hand, fully developed gonorrhœa treated with 2 to 3·5 grammes daily lost its acute character in one to three days, and with 2 to 2·5 grammes daily cleared up in three weeks without local treatment. When this form of chemotherapy was instituted first in the third week the gonorrhœa cleared up very rapidly. The author said he now allowed the first fourteen days to elapse without any other treatment than one of the ordinary bladder medicines. Then he gave DB 90 for a few days, followed by irrigation with weak potassium permanganate solution for a few days and then five or six days' treatment with DB 90, 2·5 grammes a day. In most cases the gonorrhœa seems to be cleared up in three to four weeks on this method of treatment. Cases in which the gonorrhœa is older than three weeks seem to react much better, especially if the local treatment has been omitted or only slight. In 5 out of 14 cases of this kind cure was effected by six to eight days' treatment with DB 90 alone. Six further cases treated also by irrigation were clear in ten to twenty days, 1 needed twenty-eight days, and 3 were failures. Of 20 cases of gonorrhœa in women, 17 were clear in a few days without any local treatment and the urethral infection cleared especially rapidly. The author stresses particularly that DB 90 requires for its full effect the help afforded by biological changes in the tissues designed to overcome the infection, and hence sees in it a remedy whose chief rôle is in the cure of gonorrhœa which has existed for some time. Since in women the gonorrhœa does not usually come under treatment until well developed, the preparation can be expected to afford good results rapidly.

[O. Grütz, to whose communication Felke referred in the article reviewed above, published in *Muench. Med. Woch.*, 1937, v. 84, 1201, a report on a trial of three prontosil-like preparations, DB 87, DB 90 and DB 92. In view of Felke's finding that the older infections respond better than the earlier, it is noteworthy that, of 19 cases in which Grütz reported

that one or other of these preparations had been rapidly successful, only one had had the disease for less than a week and in 15 it had been present for periods of from two weeks to several months. Of the 6 cases in which the preparations were reported to have failed, 4 had had infections of less than two weeks' duration, and of the remaining 2, in 1 treatment had had to be discontinued after three days because of headache. Grütz reported three partial failures in which after one of the three test preparations had failed another had succeeded. In none of these cases, however, had the disease lasted for more than two weeks (six, eleven and fourteen days), and Felke's finding that this kind of chemotherapy acts best when the tissues are getting the upper hand of the infection suggests that possibly the success of the second preparation tried was due not so much to the inherent superiority of the preparation as to the lapse of time and the acquisition by the tissues of power to make use of it. Grütz reported rather a high incidence of toxic effects, chiefly headache and exanthemata, but none of them remained long after discontinuance of the remedy. DB 90 is issued by Bayer Products Ltd. under the name of "Uleron Brand of Diseptal." At the time of writing (December, 1937) it is not yet on the market.]

L. W. HARRISON.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 1.*

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## Reviews.

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POISON : THE HISTORY, CONSTITUTION, USES AND ABUSES OF POISONOUS SUBSTANCES. By Hugo Glaser. (Translated into English by Marguerite Wolff). London: Hutchinson's Scientific and Technical Publications. 1937. Pp. 292. Price 8s. 6d.

In the introductory chapter the author, amongst other things, discusses the relationship between women and poison. He advances the view that secrecy and cunning, the qualities required for planning a murder by poison, are often attributes of feminine weakness. Above all these differences is the sexual background with its element of despised love, antipathy for the husband and longing for permanent union with the beloved.

Then follow chapters on gas and gas warfare. Here there is the astonishing statement that the allies used gas some months before it was employed by the Germans.

A chapter is devoted to tobacco. The history of its discovery is related in a very interesting manner. Dealing with smoking amongst women Professor Lewin's views are given. He is strongly opposed to cigarette smoking in young women. He writes: "As vestals of the home women have very different fires to tend. After all a woman's mouth is made for better things than to smoke like a chimney and reek of tobacco juice."



Alcohol, cocaine, opium, arsenic and many other poisons are dealt with very fully. The aspect of treatment is not considered.

This book should prove of considerable value to those interested in poisons, historically and otherwise.

**ELEMENTS OF SURGICAL DIAGNOSIS** (Eighth Edition). By Sir A. Pearce Gould, K.C.V.O., C.B.E., M.S., F.R.C.S. Revised by Eric Pearce Gould, M.D., M.Ch.Oxon., F.R.C.S.Eng. London: Cassell and Co., 1937. Pp. xiv + 718. Price 10s. 6d net.

The eighth edition of this well-known book has been revised by Mr. Eric Pearce Gould. He has brought it thoroughly up to date and added a number of excellent reproductions of radiograms, without altering the scope and size of the work.

The book is one which can be carried in an overcoat pocket and yet provides a diagnosis for practically every condition with which a surgeon may have to contend.

The principle followed is the excellent one of working from the symptom or sign back to the diagnosis. It is refreshing in these days when the tendency is to call on the services of the pathologist or radiologist for the provision of a diagnosis, to find it presented in a few lines from a consideration of purely clinical observations.

To do so in so small a space naturally requires dogmatism on the part of the author, and in many cases one must admit that diagnosis is not as simple as it sounds on reading this book.

There are of course certain omissions—e.g. no reference to plantar warts in the description of diseases of the sole of the foot; the value of a lateral X-ray in a case of renal calculus is not mentioned; nor is it stressed that in intestinal obstruction a single enema may produce a normal evacuation.

But the remarkable thing is that in covering such a large field so few points have been omitted.

For anyone who wishes to get a grasp of the essential points of diagnosis from a clinical examination and as a means of rapidly refreshing his memory of the possible causes of some particular condition the book is excellent and can be strongly recommended.

C. M. F.

**BRITISH MUSEUM (Natural History), Economic Series No. 5: The Bed Bug.** Fourth Edition. By A. W. McKenny-Hughes, D.I.C., Assistant Keeper of Entomology. Printed by order of the Trustees of the British Museum. 1937. Price 6d.

This booklet, revised and brought up to date, gives detailed information regarding the bed bug and its prevention.

The distribution, external appearance, sucking apparatus and life history are very adequately dealt with. One section is devoted to its habits and biology.

The question of dissemination is discussed adequately. The seriousness

of the bug menace is impressed on us by the statement that at least 4,000,000 people in Greater London are to some extent troubled by this pest. The author considers that the chief means of dissemination is the carriage of the insects in furniture and bedding.

Information is given as to where to look for bed bugs. It is stressed that sleepless nights and the constant irritation due to the injection of minute doses of the bug saliva are often the cause of ill-health in children and at times in adults.

The present situation as regards control of the bed bug is well reviewed and the necessity for thorough cleanliness as one of the greatest safeguards is emphasized.

The author recommends in mild infestations the use of "contact insecticides," in other words substances which do not give off a vapour but must come into physical contact with the insect in order to kill it. These may be sprayed into cracks and crevices and are usually a combination of paraffin and an additional toxic agent such as pyrethrum or derris. Such insecticides are of particular value when tenants cannot be moved from their homes.

Detailed attention is given in regard to fumigation with hydrocyanic acid gas and the precautions necessary. For sulphur dioxide 7 pounds per 1,000 cubic feet of air space is recommended. While for various reasons it is admitted that this fumigant is unsatisfactory, the author states that used in ideal conditions it is likely to be found effective in five out of every six houses.

As a substitute for the dangerous hydrocyanic acid gas and the rather unsatisfactory sulphur dioxide, heavy naphtha, a white or slightly yellow liquid with a characteristic smell, has been tried applied as a spray (1 gallon per 750 cubic feet). Although the liquid kills the insects on contact, the effects are mainly due to the vapour. The exposure given is eighteen to twenty-four hours, and except in summer preheating of the house to 80° or 90° F. is recommended. In experiments carried out up to July, 1937, over 800 houses and tenements have been treated with comparatively few failures.

The booklet is likely to prove of considerable value to all those interested in the elimination of this comparatively ubiquitous insect, and the author is to be congratulated on presenting the essential factors in the situation in such an interesting manner.

A. E. R.

CLINICAL CHEMISTRY IN PRACTICAL MEDICINE (Second Edition). By C. P. Stewart, M.Sc., Ph.D., and D.M. Dunlop, B.A., M.D., F.R.C.P.E. Edinburgh: E. and S. Livingstone. 1937. Pp. x + 372. Price 10s. 6d. net.

Nowadays some knowledge of biochemical methods is essential to every one engaged in clinical practice if only to enable him to understand what assistance can be expected from this method of investigation in elucidating his medical problems.

In this volume a most useful fund of information is available. The new edition has been brought well up to date. The authors point out in the introduction that chemical methods, like other laboratory methods, must be used simply to supply the evidence which the diagnostician has then to consider along with his clinical findings and all other available information; they should supplement but not replace clinical examination.

The book contains a concise and very readable description of all the more important biochemical tests emphasizing not only their values but also their limitations. A useful discussion on the interpretation of the results is given in most chapters.

The clinician should find this a most useful addition to his library.

### Notices.

#### CHADWICK PUBLIC LECTURES, 1938.

Date and Time	Place	Lecturer	Subject	Chairman
1938. March. Thursday, 24th, 5.30 p.m.	LONDON. London School of Hygiene. Keppel Street, Gower Street, W.C.1	W. J. E. Binnie, Esq., M.A., M.Inst.C.E., M.Inst.W.E., F.G.S.	Water Supply in Relation to Public Health	Sir George W. Humphreys, K.B.E., M.Inst.C.E., Chadwick Trustee
May. (provisionally) Thursday, 5th 5.30 p.m.	London School of Hygiene. Keppel Street, Gower Street, W.C.1	Prof. Ernest Barker, Litt.D.Camb., D.Litt.Ox., LL.D.Ed., LL.D.Harvard	The Community Centre in Rela- tion to Public Health and Public Welfare	Sir William J. Collins, K.C.V.O., M.D., M.S., F.R.C.S., B.Sc., Chair- man of the Chadwick Trustees
To be announced	Institution of Mechanical Engineers, Storey's Gate, St. James's Park, Westminster	Prof. H. J. Collins, M.C., M.Sc., M.Inst.C.E., M.Mech.E., M.I.Struct.E. Chadwick Professor of Engineering, Univer- sity College, London	BOSSOM GIFT LECTURE: Engineering Problems of Modern Building Construction	To be announced
June. Thursday, 9th, 5 p.m.	The Chelsea Physic Garden, Swan Walk, S.W.3	Prof. E. J. Salisbury, F.R.S., D.Sc., F.L.S.	Plants in Rela- tion to the Human Environ- ment. 1, Influe- nce of Plants on Environmental Conditions; 2, The Role of Vege- tation in Rela- tion to Water Table and Ero- sion; 3, The Amenity Aspects of Vegetation; 4, Nature Re- serves and Road- side Planting	Sir William J. Collins, K.C.V.O., M.D., M.S., F.R.C.S., B.Sc., Chair- man of the Chadwick Trustees

# THE ROYAL SANITARY INSTITUTE.

## THE HEALTH CONGRESS.

THE Right Hon. the Earl of Besborough has consented to act as President of the Health Congress of the Royal Sanitary Institute which is to be held at Portsmouth from July 11 to 16, 1938.

The Congress will be divided into sections dealing with

Preventive Medicine.

Architecture, Town Planning and Engineering.

Maternity, Child Welfare and School Hygiene.

Veterinary Hygiene.

National Health Insurance.

Hygiene of Food.

Tropical Hygiene.

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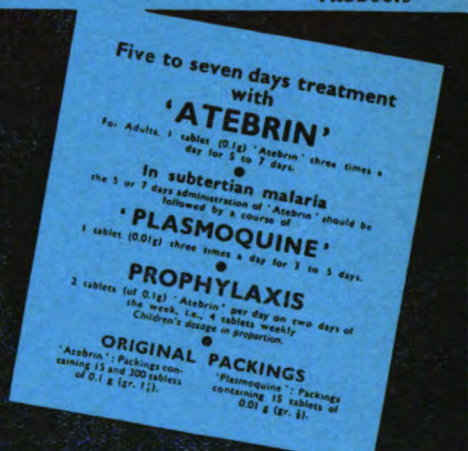
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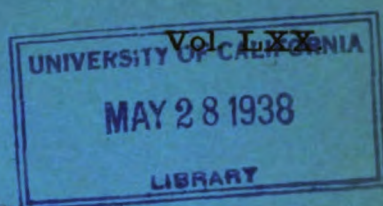
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No. 5.

May, 1938.

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OF

THE

## Royal Army Medical Corps



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ACTIVE IMMUNIZATION AGAINST TETANUS.

BY MAJOR J. S. K. BOYD,  
*Royal Army Medical Corps.*

*(From the Department of Pathology, Royal Army Medical College.)*

PART I.—HISTORICAL REVIEW.

"IN former wars tetanus was a calamity to be recorded and deplored: the War of 1914-1918 has shown that it is one which can largely be prevented."

Thus writes the Official Historian of the Great War, and few will deny that his claim is justified.

In Graph I (Cummins, 1920) the incidence of tetanus month by month throughout the War is shown in terms of cases per 1,000 men wounded. In the first two months there were no special arrangements for prophylaxis, and over 8 cases per 1,000 wounded occurred. In October, 1914, an order was issued that every wounded man should be given 500 units of tetanus antitoxin. This procedure was put into effect as rapidly as possible, and by December the incidence of tetanus fell to a little over 1 per 1,000, a level which remained a rough average throughout 1915. In 1916 there was a considerable increase, partly at least because of the occurrence of tetanus in cases of trench foot, and in June, 1917, it was decided to extend the existing procedure and to give four doses of antitoxin to every wounded man. Although this instruction was not invariably followed, from this time until the end of the War the average incidence was below 1 per 1,000.

Late in 1918 the initial dose of antitoxin was raised to 1,500 units, but as the War ended shortly after this step was taken it is impossible to assess its value.

Not only did the incidence of cases of tetanus decrease as a sequel to prophylactic treatment with antitoxin, but there was also a decrease in mortality. This is shown in Table I, where the figures for 1914-15, and for 1918, are compared.

TABLE I.  
*Percentage Mortality in Cases of Tetanus.*  
*Great War, 1914-1918.*  
*(Abstracted from the Official History of the War.)*

	1914-15	1918
Among patients in France	78·2	58·6
Among patients evacuated to U.K.	55·5	26·3

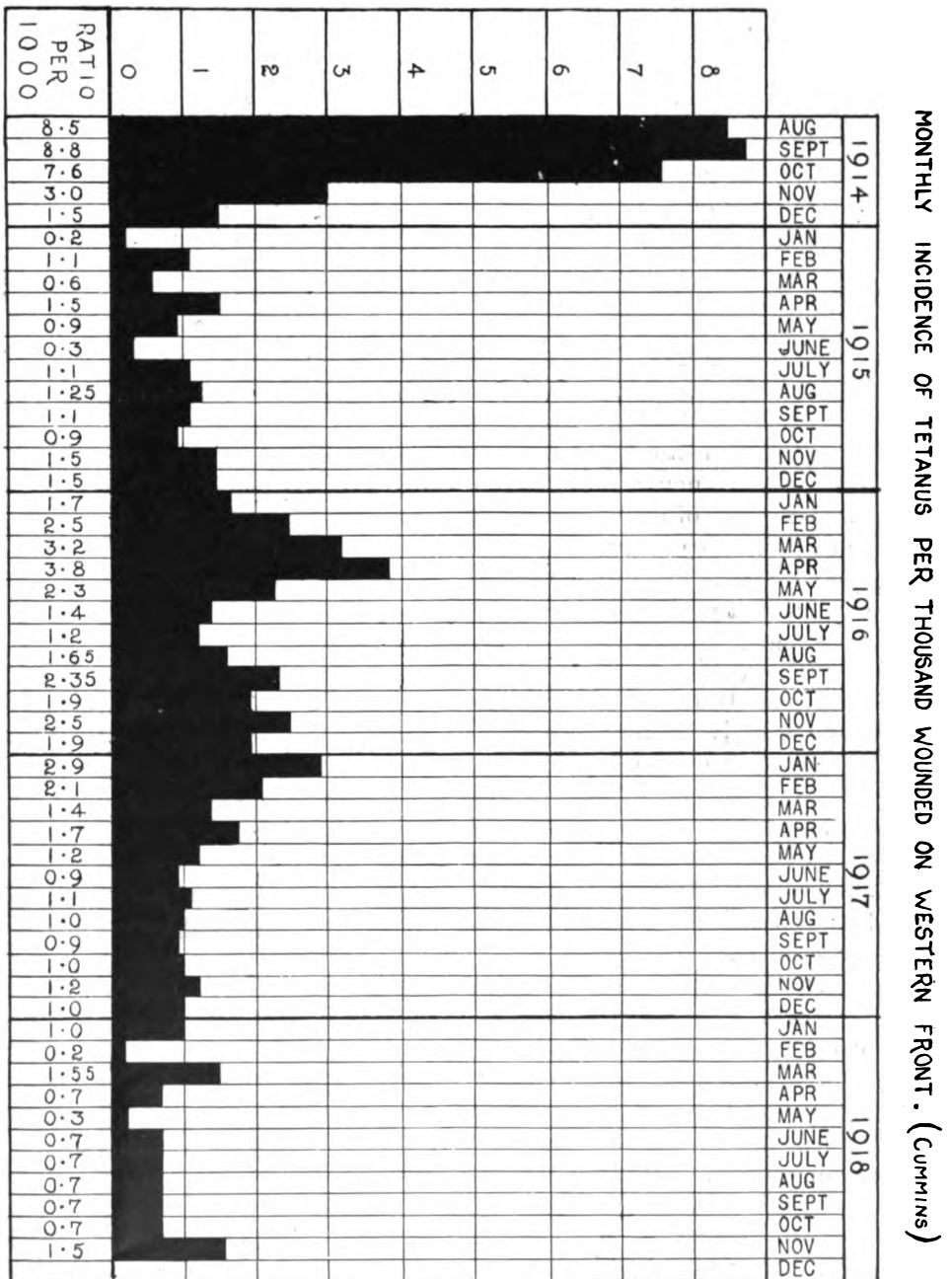
While there is no doubt that improved methods in the local treatment of wounds played their part in reducing the number of cases of tetanus, the principal credit must be given to the passive immunity conferred by the administration of tetanus antitoxin.

#### **Disadvantages of Antitoxin Prophylaxis.**

Despite these very gratifying results, it was fully recognized by those whose experience was greatest that prophylaxis by passive immunity was far from ideal, and presented many disadvantages and shortcomings.

To ensure its effective action, it is essential that antitoxin should be given as soon as possible after the patient is wounded. This is frequently impossible in the most needful cases, as for example in badly wounded men who cannot immediately be rescued.

Again, passive immunity conferred by antitoxin is evanescent. When injected, the highly concentrated antitoxin is absorbed, and can be detected in the serum, much diluted, but nevertheless in an effective concentration. In the normal subject it is gradually either destroyed or excreted, so that in course of time it reaches an ineffective low level. An experiment carried out during the War is cited in the Official History. Healthy volunteers were given a dose of 1,700 units of antitoxin, and thereafter blood was drawn at intervals, pooled, and tested. After three days the titre was 0·133 unit per cubic centimetre of serum, after ten days less than 0·1 unit, and after twenty days just over 0·05 unit. It is commonly stated that within a fortnight the concentration of antitoxin resulting from a single prophylactic dose is insufficient to prevent infection. This is based on clinical observation and is probably correct. The figures just quoted show the



GRAPH I.

rate of elimination in a normal individual, and do not take into account the antitoxin which would be used up in neutralizing toxin in a case of tetanus infection, where toxin production is continuous. It is therefore necessary, in order to maintain a state of protection, to repeat the administration of antitoxin at weekly intervals until such time as the possibility of active tetanus infection in the wound can be excluded.

The possibility of latent infection with tetanus spores, which may not show itself until brought to light by some trauma or surgical interference at a distant date, can never be excluded with certainty, and against this the injection of antitoxin at the time of wounding is without effect.

Serum sickness in its various forms always appears in a proportion of cases treated with antitoxin. Schaër (1934) examined the records of a large number of cases, and found that approximately 10 per cent developed symptoms of greater or lesser severity. Occasional cases of acute anaphylaxis occur, and the administration of serum of any kind at a later date is complicated by the sensitization to horse-serum which may be present.

Finally, the infection may be so intense that the antitoxin administered is insufficient to neutralize the toxin which is produced, and symptoms supervene in spite of treatment. That this is a real danger is clearly borne out by certain experiments made by Sneath, Kerslake, and Scruby (1937), who found that, in certain cases, doses of 1,500 units given to a guinea-pig failed to prevent symptoms when subsequent artificial infection with spores was performed.

#### **Active Immunization.**

It will readily be acknowledged that all these disadvantages would be overcome if active immunity could be substituted for passive immunity, and if each subject could himself be made a permanent reservoir of antitoxin, ready for immediate action should it be required. With this object in view, extensive experiments have been made by workers in different parts of the world.

The initial difficulty in the immunization of man against tetanus lay in the lack of a suitable immunizing agent. In the early days of the manufacture of antitoxin, horses were immunized by giving increasing doses of tetanus toxin, a procedure not free from danger and quite unsuitable for use in the human being. Ramon (1924) discovered that toxin, if treated with a low concentration of formalin and kept at a temperature of 37° C. for approximately a month, loses its toxic action but retains its antigenic properties. Descombey (1924) studied and confirmed this phenomenon in relation to tetanus toxin. He found that tetanus toxin, of such potency that minute doses of the fresh product killed a guinea-pig, was converted by this process to a substance which could be administered in doses of 5 to 10 cubic centimetres without causing symptoms. This altered toxin was named "anatoxin" by Ramon, but, on account of possible confusion with the word "antitoxin," it is more commonly known as "toxoid."

Experiments in immunization with tetanus toxoid were first carried out on laboratory animals and horses. The inoculations gave rise to no



ill-effects and produced satisfactory immunization which could be tested by estimating the concentration of antitoxin in the serum.

Subsequent experiments were carried out on man, the first published results being those of Ramon and Zoeller (1927). Since then the principal findings of these workers have been repeatedly confirmed by others, and many different aspects of the question have been investigated in great detail. As a matter of convenience the various aspects of the subject will be presented in logical order rather than in the order of their study and elucidation.

#### *Standard of Toxoid.*

At present there is no fixed standard for tetanus toxoid in this country. Ramon and his co-workers titrate toxoid by means of the flocculation test, and define as an antigenic unit the quantity of anatoxin (toxoid) which gives standard flocculation with one unit (American) of antitoxin. The accuracy of this method of titration is not, however, universally accepted, and the question of a more reliable method is under consideration. Despite the absence of an agreed standard, the methods by which toxoid has been prepared in different laboratories are fairly constant, and the results obtained by various workers have been sufficiently consistent to justify the assumption that there has been no gross variation in the potency of the various toxoids which have been used.

#### *Dose.*

The dose administered to man by different observers has varied from 1 to 2 cubic centimetres. Some report a trifling local and general reaction in a few cases, but the majority of workers found no reaction worthy of mention. It is obvious that quantities of 2 cubic centimetres, unless given more slowly than is practicable in carrying out routine inoculations, must cause a certain amount of local pressure and trauma, so that local tenderness for a day or two after such an injection is to be expected. As very satisfactory results have been obtained with doses of 1 cubic centimetre, there seems no reason to exceed this quantity.

#### *Route of Inoculation.*

Inoculation by the subcutaneous route has proved satisfactory and safe: intramuscular injection has no advantages to commend it. Ramon and Zoeller report that anatoxin given by the mouth produces a limited degree of immunity in rabbits and guinea-pigs, but is ineffective in man.

#### *Number of Doses and Interval between Doses.*

The number of doses to be given, and the optimum interval between doses, are points which are closely inter-related.

Certain very important facts bearing on this question were observed by Ramon and Zoeller (1927) early in the course of their experiments. They may be summarized as follows:—

The first injection of toxoid produces little or no antitoxin in the serum, but it brings into being “a remarkable aptitude to react to subsequent doses of anatoxin.”

A second injection given fifteen days later produces in ten days from 0·001 to 0·01 unit of antitoxin per cubic centimetre of serum.

*Note.*—In order to establish uniformity, and to allow the findings of workers in different countries to be compared, all results in this paper are expressed in terms of American units of antitoxin. The American unit is equivalent to two International units, the latter being the standard adopted in this country and Germany.

When the second injection is given three weeks after the first, 0·01 to 0·02 unit of antitoxin is produced.

By giving the second dose a month after the first, a titre of 0·1 unit results.

If a third inoculation is given eight days after the second, there is an immediate and well-marked response, and the antitoxin may rise to 1 or more units per cubic centimetre of serum.

This third inoculation was named by Ramon *l'injection de rappel*. He found that it was effective only when there was a fairly long interval (i.e. a month or more) between the first and second doses. It was later discovered that *l'injection de rappel* or "boosting dose" is equally, if not more, effective when given a year or more after the original immunization. It is believed that the original inoculations establish a reacting mechanism—probably in the reticulo-endothelial system—which is more or less permanent in nature, and which when acted on by toxoid is immediately stimulated to produce large quantities of antitoxin.

The system of inoculation with formol toxoid advocated by Ramon and his colleagues is to give three injections, the first of 1 cubic centimetre, the second, a month later, of 1·5 cubic centimetres, and the third, ten to fifteen days later, of 1·5 cubic centimetres, the last being designed to act as an *injection de rappel*. With this method they claim to obtain a titre of from 0·1 to 1 unit of antitoxin per cubic centimetre of serum. This three-dose system of giving formol toxoid (as opposed to alum-precipitated toxoid which will be mentioned later) has been followed by most workers on the Continent and in America and Canada.

Experiments which will be detailed at a later stage in this article show that it has been possible to produce equally good results with a two-dose system, leaving a longer time to elapse between the two doses.

#### *Concentration of Antitoxin in the Serum which confers Protection against Tetanus Infection.*

It has generally been assumed that when the concentration of antitoxin in the serum of an animal, human or otherwise, reaches or exceeds a certain level, it affords protection against infection with tetanus spores. Ramon and Zoeller state that in the horse 0·001 unit per cubic centimetre of serum—that is, sufficient to neutralize one minimum lethal dose of toxin—will protect the animal from infection when a splinter of wood charged with spores is inserted into a muscle. They regard the horse and man as about equally susceptible to tetanus. Sneath, Kerslake, and Scruby (1937) have carried out some interesting experiments on this point (reviewed in this Journal, November, 1937, p. 352). These workers first established a

standard technique for introducing measured doses of spores, using calcium chloride as an irritant to ensure their development. They then immunized guinea-pigs in varying degrees, estimated the antitoxin content of their serums, and injected infective doses of spores. Forty-five animals had a titre exceeding 0.01 unit of antitoxin per cubic centimetre of serum: these all survived. Seven had a titre ranging from 0.001 to 0.01: of these four died. The dose of spores injected was invariably fatal to unprotected animals, and produced either fatal or modified tetanus in about 75 per cent of animals to which a dose of 1,500 units of antitoxin was administered immediately after the introduction of the spores. From these results the authors conclude that an antitoxin content of 0.01 unit or over per cubic centimetre of serum confers protection against tetanus.

Unfortunately these observations, in so far as they have been published, fail to record one very important point, namely, the level of antitoxin *after the experiment* in those animals which survived infection, and especially in those which had initially a low antitoxin titre.

This point has a very close bearing on the problem of active immunization. It has already been noted that reinoculation of an immunized subject with a further dose of toxoid will lead to an immediate and vigorous production of antitoxin resulting from the stimulation of the sensitized reticulo-endothelial cells, or whatever the reacting mechanism may be. If toxin has in this respect the same properties as toxoid (and it is reasonable to assume that it has) then the first few molecules of toxin produced from the germinated spores in an infected wound will set this mechanism in action and lead to an outpouring of antitoxin. If under these circumstances antitoxin is produced with the same rapidity as it is following toxoid stimulation, it is probable that the curve of antitoxin production will exceed and dominate the curve of toxin production, so that effective neutralization of the toxin will ensue.

This assumption could readily be proved by experiments on lightly immunized animals. Strange to relate, the only experiments of this nature which can be traced lead the authors of the work to draw an opposite conclusion. Jones and Jamieson (1936) immunized guinea-pigs so that their serums contained four or more units of antitoxin per cubic centimetre of serum, and subsequently injected massive doses of spores which were rapidly fatal to control animals. The test animals were unaffected, and at a subsequent test the titre of antitoxin in their serums was found unchanged. Jones and Jamieson conclude from this that the inoculation of spores does not stimulate the production of antitoxin. Their findings are, however, susceptible of a different explanation. The titre of antitoxin in the test animals was so high that it is probable that the toxin produced by the germinated spores was immediately neutralized and failed to reach the reacting mechanism in a form capable of provoking antitoxin production. This explanation is in conformity with certain observations made regarding toxin-antitoxin mixtures, where it was found that over-neutralized toxin lost its antigenic properties; and it is more convincing than the assumption,



underlying the conclusion drawn by Jones and Jamieson, that toxoid possesses an antitoxin-stimulating property which natural toxin lacks.

If these ideas are correct, then the level of antitoxin in the serum is not the sole criterion of immunity: the property of producing antitoxin in response to stimulation with toxin plays an even more fundamental part. Where the antitoxin titre is sufficiently high there is no doubt that, as shown by Jones and Jamieson, direct neutralization of toxin will occur without the immediate intervention of the antitoxin-producing mechanism. But where the titre is low, but is backed up by a sensitive reacting mechanism, there is reason to believe that protection will be maintained by a rapid production of antitoxin in response to the first threat of invasion by toxin. Only when large quantities of toxin are suddenly introduced, an improbable occurrence under natural conditions of infection, is this defensive mechanism likely to be submerged and overcome.

#### *Duration of Immunity.*

The persistence of active immunity against tetanus, conferred by inoculation with toxoid, is closely linked up with these matters which have just been discussed.

One aspect of the question can be followed by titrating the serum of immunized subjects at increasing intervals after inoculation. Several investigations of this kind have been carried out and all show that the antitoxin titre of the serum declines very slowly. The figures given by Ramon and Zoeller (1933) cover the longest interval of time. A number of men immunized by them had a titre of from 0.1 to 1 unit per cubic centimetre of serum shortly after they were inoculated. Thirteen of these men were examined four to five years later. One showed a titre of 0.004 unit per cubic centimetre, eleven ranged between 0.01 and 0.1, and one reached 0.3 unit. In Ramon's opinion this is well above the level necessary to confer immunity against infection with tetanus spores. Sneath and Kerslake (1935) also tested 13 subjects one and two years after immunization. There was some decline in the antitoxin level at the end of one year, but little appreciable difference between the figures obtained then and those found at the end of two years. With one exception—a subject who reacted badly in the first instance and never showed above 0.003 unit—all were at a level of 0.01 and over after two years. All reacted well to a boosting dose given at this stage, including the backward reactor, whose serum after one month contained 0.025 unit per cubic centimetre. Certain figures given by Sneath and Kerslake are analysed in Tables II and III.

No definite figures are available showing the maximum number of years during which the reacting mechanism remains susceptible to stimulus. As demonstrated by Sneath and Kerslake it is still active after two years. Ramon (1936) states that the *injection de rappel* is effective after several years, and recommends reinoculation every five years.

It is by no means improbable that this basal immunity may be lifelong, but this is a point which can only be established by further experimentation and observation.

TABLE II.

*Analysis of results in 13 cases given a primary inoculation of 3 doses, and a subsequent injection of 1 c.c. after two years. Adapted from Sneath and Kerslake (1935).*

Antitoxin units per c.c. of serum	Number of cases showing antitoxin as indicated marginally			
	After the primary inoculation			Maximum after the "boosting" dose
	Maximum	After 12 to 15 months	After 2 years	
< 0.01	1	3	1	—
0.01 to < 0.1	2	7	9	1
0.1 to < 1	10	2	3	1
1 to < 5	—	—	—	5
Over 5	—	—	—	5
Untested	—	1	—	1

TABLE III.

*Analysis of results in 10 cases given a primary inoculation of 3 doses, and a subsequent injection of 1 c.c. after one year. Adapted from Sneath and Kerslake (1935).*

Antitoxin units per c.c. of serum	Number of cases showing antitoxin as indicated marginally				
	After primary inoculation		After the "boosting" dose		
	Maximum	12 to 15 months	1 week	1 month	1 year
< 0.01	—	—	—	—	—
0.01 to < 0.1	2	7	—	—	1
0.1 to < 1	7	2	3	2	9
1 to < 5	1	—	5	7	—
Over 5	—	—	2	1	—
Untested	—	1	—	—	—

Some interesting observations on the persistence of immunity in horses have been made by Ramon and Lemétayer (1936). Since 1928 more than 50,000 horses of the French Army have been immunized against tetanus. All have received at an interval of one month two initial doses of ten cubic centimetres of anatoxin, and 35,000 have received a third dose of the same quantity at varying intervals up to two years after the primary inoculation.

Ramon and Lemétayer have tested the serum of twenty-six horses, casually selected, which were inoculated several years previously. Twenty-two showed 0·03 unit and over per cubic centimetre of serum. All, with one exception, had more than 0·001 unit, which the authors consider to be the titre necessary to protect the horse against experimental infection.

Further, no case of tetanus has occurred in the 35,000 horses which received three doses; cases were very rare in animals which received only two initial doses, while they occurred with the usual frequency in unprotected horses. Unfortunately no figures are given in illustration of the last two categories.

#### *Tetanus Alum-precipitated Toxoid.*

Following the work of Glenny (1930) on the use of alum-precipitated toxoid in the immunization of guinea-pigs and horses, various experiments have been made with this preparation both in animals and man.

Bergey (1934) and Bergey and Etris (1934 and 1936) were able to follow up the results of thirty cases immunized by two doses of one cubic centimetre of alum-precipitated toxoid, given at an interval of "several" months. These results are analysed in Table IV.

TABLE IV.

*Analysis of the results in 30 cases immunized with 2 doses of 1 c.c. of alum-precipitated toxoid, given at an interval of some months. After Bergey and Etris (1936).*

Antitoxin units per c.c. of serum	Number of cases showing antitoxin as indicated, at intervals after the second inoculation		
	1 month	1 year	2 years
<0·01	—	—	5
0·01 to < 0·1	—	13	12
0·1 to < 1	14	10	12
1 to < 5	10	2	1
5 to < 10	6	—	—
Not tested	—	5	—

Gold (1937) immunized two series of subjects. The first received two doses of 0·5 cubic centimetre at an interval of ninety-two days, the second two doses of 1 cubic centimetre at the same interval. The titre was noticeably higher in the 18 subjects who received doses of 1 cubic centimetre, and the results in this series are analysed in Table V.

TABLE V.

*Analysis of the results in 18 cases immunized with 2 doses of 1 c.c. of alum-precipitated toxoid, given at an interval of 92 days. After Gold (1937).*

Antitoxin units per c.c. of serum	Number of cases showing antitoxin as indicated, at intervals after the second inoculation		
	1 to 2 weeks	3 months	6 months
< 0.01	—	—	1
0.01 to < 0.1	1	2	7
0.1 to < 0.25	1	2	6
0.25 to < 1	12	13	2
1 and over	4	1	—
Not tested	—	—	2

Hall (1937) gave 13 subjects 2 doses of 1 cubic centimetre of alum-precipitated toxoid at six weeks' interval, followed by a third dose nine months later. The results are analysed in Table VI.

TABLE VI.

*Analysis of the results in 13 cases immunized with 2 doses of 1 c.c. of alum-precipitated toxoid given at 6 weeks' interval, and a third dose given 9 months after the basic inoculation. After Hall (1937).*

Antitoxin units per c.c. of serum	Number of cases showing antitoxin as indicated		
	After primary 2 doses		After 3rd dose
	6 weeks	9 months	7 days
< 0.01	—	—	—
0.01 to < 0.1	—	12	—
0.1 to < 1	12	1	—
1 to < 5	1	—	5
5 to < 10	—	—	4
10 to < 25	—	—	3
Over 25	—	—	1

Hall's figures lend themselves to comparison with those of the formol-toxoid method, and it will be seen that the titre reached after the basic inoculation is very similar to that obtained by Ramon and Zoeller, Sneath and Kerslake, and others. The effect of the *injection de rappel* is well illustrated in the fourth column of the table. Gold's figures for primary inoculation are very similar. Bergey and Etris have produced a higher

average titre, but the time which elapsed between the two doses was greater, and in some cases as long as nine months, so that in these it must have been in the nature of an *injection de rappel*. The subsequent fall in titre is relatively rapid, and the average titre two years later is not much higher than the average titre in Sneath and Kerslake's series (Table II).

The available data are obviously inadequate, but as far as they go would appear to show that when the doses of alum-precipitated toxoid are given at long intervals a rather higher titre is obtained than is given by Ramon's three-dose method. On the other hand, there is nothing to show that the basal immunity which is established is any more effective.

Alum-precipitated toxoid gives occasional local reactions. Hall reports that there is a good deal of induration at the site of injection which persists for about forty-eight hours when the injection is intramuscular, and longer when it is subcutaneous.

*Further Treatment of Immunized Subjects who have been Exposed to Tetanus Infection.*

Ramon and Zoeller recommend that when an immunized subject is exposed to the risk of tetanus infection by wounding or otherwise he should be treated simultaneously with antitoxin and anatoxin. The former affords immediate protection, while the latter, acting as an *injection de rappel*, rapidly enhances his antitoxin production, so that active immunity comes into play before the passive immunity conferred by the injection of antitoxin has faded.

Others criticize this proposal by saying that if these two products are given simultaneously, the antitoxin will over-neutralize the toxoid and destroy its antigenic properties. On the other hand, alum-precipitated toxoid is absorbed very slowly, and Wolters and Dehmel (1938) have found in experiments with guinea-pigs that this preparation can be given at the same time as antitoxin and still produce a satisfactory response.

From the figures which have been presented it will be clear that no treatment of any kind is necessary in the man who has a satisfactory titre of antitoxin. Unfortunately there is no simple test, analogous to the Schick test, for determining the level of tetanus antitoxin in the serum. In the absence of such a test, and until further experimentation and observation have settled the questions of (a) the persistence of basal immunity in all subjects who have been inoculated with toxoid, and (b) the rôle of naturally produced toxin in stimulating antitoxin production, it will be necessary to adopt some procedure of this kind to protect the weaker links in the chain.

There is, however, good reason to hope that in time it will be established that inoculation with toxoid confers a solid immunity against tetanus of long—possibly life-long—duration. This optimistic outlook finds encouragement in the very good results which have been obtained by the active immunization of horses.

*Combined Administration of Tetanus Toxoid and T.A.B. Vaccine.*

The combined administration of tetanus toxoid and T.A.B. vaccine was first reported by Ramon and Zoeller (1927), who found that no increased reaction resulted from this procedure, and that the antitoxin response was better when toxoid was given in this way than when it was given by itself. Such a result is, of course, in keeping with the observation which has frequently been made that the co-administration of irritants enhances the action of toxoid. Tapioca is used for this purpose in immunizing horses in France.

This observation has been repeated and confirmed [Sacquépée *et al.* (1936), Sasaki and Stetkiewicz (1935)], and in 1936 inoculation against tetanus (as well as against diphtheria) was made compulsory in the French Army, Navy and Air Force. The toxoids used for immunization are administered simultaneously with T.A.B. vaccine (already compulsory) if necessary.

The system of combined *antitetanique-antityphoparatyphoidique* inoculation recommended in France is three injections at three weeks' interval of 2 cubic centimetres of mixed vaccine (suspension of T.A.B. vaccine in anatoxin). If there is great urgency the interval between doses may be reduced to two weeks.

## PART II.—EXPERIMENTS IN ACTIVE IMMUNIZATION.

The investigations which will now be detailed were undertaken at the Royal Army Medical College in order to obtain direct experience in immunization against tetanus, to test the various preparations which might be used for this purpose, and to ascertain if adequate immunization could be obtained with two instead of three doses of toxoid.

This work has been carried out in collaboration with Dr. R. A. O'Brien, C.B.E., and his staff at the Wellcome Research Laboratories, who prepared the various toxoids which have been used, and performed the titrations of antitoxin.

Short articles on the preparation of formol toxoid and alum-precipitated toxoid, and on the laboratory control of tetanus prophylaxis, follow this paper.

**Tetanus Toxoid-Antitoxin Floccules.**

The first product to be used was tetanus toxoid-antitoxin floccules, prepared along the same lines as diphtheria T.A.F. As this preparation had not previously been tested on man, a very careful beginning was made, the first volunteer being given 0.1 cubic centimetre, the second, two days later, 0.2 cubic centimetre, and so on until a dose of 1 cubic centimetre was reached. No local or general reaction of any kind occurred. A month after the first dose all received a second dose of 1 cubic centimetre, and the serum was subsequently tested after intervals of one and two months (*see* Table VII).

In all cases the antitoxin production was negligible, and in two months only a faint trace was present in four out of seven. On account of this very poor response, and of the difficulty in preparing floccules—for this is a much more elaborate process than the preparation of simple formolized toxoid—it was decided not to pursue further the investigation of this preparation, and to turn to formol-toxoid.

Nevertheless these tests with floccules led to one very interesting observation. Nine months after inoculation with floccules three of the volunteers were given a single dose of 1 cubic centimetre of formol-toxoid. Two of these subjects, tested after a month, showed no less than 2 units of antitoxin per cubic centimetre of serum; while the third, whose absence on leave prevented a test being made until fifty-six days after reinoculation, showed at that time between 10 and 20 units. From these results it may be concluded that inoculation with floccules established a basal immunity although it failed to produce antitoxin in the serum; and, as a corollary, that the concentration of antitoxin in the serum is no index of the potential activity of the reacting mechanism.

#### Tetanus Toxoid.

Tests with tetanus toxoid (i.e. formol-toxoid) were started with due caution, and the first few volunteers were given small but increasing doses until it was established that toxoid produced no reaction. It may be stated here that this observation held good throughout all the experiments made with tetanus toxoid; no obvious reaction of any kind, local or general, occurred in any of the volunteers inoculated with this preparation. Four of these cases were given a further two doses at the intervals shown in Table VIII. The final results are satisfactory, and compare favourably with those obtained by Continental and American workers.

Glenny *et al.* (1925) have pointed out that in immunizing animals with toxoid it is of advantage to allow a long interval to elapse between the first and second doses. This principle has been confirmed and accepted, but nevertheless in immunizing man with formol-toxoid, four weeks is the interval which has been generally adopted. It was decided to experiment with a longer gap between doses in the hope that in this way it might be possible to effect satisfactory immunization with two instead of with three doses.

Thirteen volunteers were given a preliminary dose of 1 cubic centimetre of toxoid. From twenty-one to twenty-six days later five of these men were given a second dose of 1 cubic centimetre, and a month thereafter samples of blood were drawn and tested for antitoxin. The results are shown in Table IX where it will be seen that the antitoxin titre varied from 0·005 to 0·02 unit of antitoxin per cubic centimetre of serum, a concentration which cannot be regarded as adequate.

The remaining eight men were given a second dose from six to seven weeks after the first, and tested four weeks later. As the results proved

TABLE VII.

*Tetanus Toxoid-Antitoxin Floccules.**Re-inoculation with Tetanus Toxoid.*

Case	1st dose	Interval	2nd dose	Interval until tested	Units of antitoxin		Interval	Dose of toxoid	Interval until tested	Units of antitoxin
					1 month	2 months				
1	0.1 c.c.	31 days	1 c.c.	26 days	< 0.001	Trace	9 months	1 c.c.	28 days	2
2	0.2 c.c.	31 days	1 c.c.	26 days	< 0.001	Trace	9 months	1 c.c.	56 days	10-20
3	0.2 c.c.	31 days	1 c.c.	26 days	< 0.001	None				
4	0.5 c.c.	31 days	1 c.c.	24 days	0.001	Trace	9 months	1 c.c.	28 days	2
5	0.5 c.c.	31 days	1 c.c.	24 days	< 0.001	None				
6	0.7 c.c.	31 days	1 c.c.	24 days	< 0.001	Trace				
7	1.0 c.c.	31 days	1 c.c.	24 days	< 0.001	None				

TABLE VIII.

*Tetanus Toxoid.*

(Immunization with 3 doses).

Case	1st dose	Interval	2nd dose	Interval	3rd dose	Interval until tested	Units of antitoxin
1	0.1 c.c.	25 days	1 c.c.	23 days	1 c.c.	32 days	0.2
2	0.2 c.c.	24 days	1 c.c.	23 days	1 c.c.	17 days	0.2
3	0.5 c.c.	46 days	1 c.c.	22 days	1 c.c.	55 days	0.5 to 1
4	0.75 c.c.	23 days	1 c.c.	23 days	1 c.c.	32 days	0.2

TABLE IX.

*Tetanus Toxoid.*

(2 doses at 3 to 4 weeks' interval.)

Case	1st dose	Interval	2nd dose	Interval until tested	Units of antitoxin
1	1 c.c.	26 days	1 c.c.	28 days	0.005
2	1 c.c.	26 days	1 c.c.	28 days	0.002
3	1 c.c.	26 days	1 c.c.	28 days	0.01 to 0.02
4	1 c.c.	26 days	1 c.c.	28 days	0.005
5	1 c.c.	21 days	1 c.c.	28 days	0.01



*Active Immunization Against Tetanus*

TABLE X.  
*Tetanus Toxoid.*  
 (2 doses at an interval of 6 weeks or over.)

Cave	1st dose	Interval	2nd dose	Interval until tested	Units of antitoxin
1	1 c.c.	43 days	1 c.c.	28 days	0.1
2	1 c.c.	43 days	1 c.c.	74 days	0.2
3	1 c.c.	43 days	1 c.c.	28 days	1 to 2
4	1 c.c.	43 days	1 c.c.	28 days	0.1
5	1 c.c.	43 days	1 c.c.	28 days	0.02
6	1 c.c.	43 days	1 c.c.	28 days	0.1
7	1 c.c.	43 days	1 c.c.	48 days	0.02
8	1 c.c.	46 days	1 c.c.	48 days	1 to 2
9	1 c.c.	46 days	1 c.c.	28 days	0.05
10	1 c.c.	50 days	1 c.c.	28 days	0.5 to 1
11	1 c.c.	46 days	1 c.c.	28 days	0.5 to 1
12	1 c.c.	46 days	1 c.c.	28 days	0.5 to 1
13	1 c.c.	46 days	1 c.c.	28 days	1
14	1 c.c.	50 days	1 c.c.	28 days	0.1
15	1 c.c.	46 days	1 c.c.	43 days	0.1 to 0.2
16	1 c.c.	46 days	1 c.c.	43 days	1
17	1 c.c.	60 days	1 c.c.	28 days	0.1 to 0.2
18	1 c.c.	46 days	1 c.c.	28 days	0.5 to 1
19	1 c.c.	46 days	1 c.c.	28 days	0.5 to 1
20	1 c.c.	46 days	1 c.c.	28 days	0.5 to 1
21	1 c.c.	46 days	1 c.c.	28 days	0.2 to 0.5
22	1 c.c.	47 days	1 c.c.	28 days	0.2 to 0.5
23	1 c.c.	43 days	1 c.c.	28 days	0.1
24	1 c.c.	43 days	1 c.c.	28 days	> 0.1
25	1 c.c.	43 days	1 c.c.	28 days	0.1 to 0.2
26	1 c.c.	43 days	1 c.c.	28 days	1
27	1 c.c.	47 days	1 c.c.	28 days	1
28	1 c.c.	43 days	1 c.c.	28 days	0.5 to 1
29	1 c.c.	43 days	1 c.c.	28 days	0.5
30	1 c.c.	47 days	1 c.c.	27 days	0.2 to 0.5

satisfactory another thirty men were started on a similar course. For various reasons several of these were drafted away before the final test was reached, and in others the exact spacing between the doses could not be followed. Ultimately, figures were available from thirty out of the thirty-eight, and these are given in detail in Table X.

Briefly summarized they show that in three the titre was between 0·01 and 0·1 unit of antitoxin per cubic centimetre of serum: in twenty-one, from 0·1 to 1 unit; and in six, 1 unit and over. These results are very much better than those obtained when the two doses were given at a three-weeks interval, and the average is far above the level believed to confer protection against tetanus infection.

### Discussion.

Figures which have been abstracted from the publications of other workers are, for purpose of comparison, placed in apposition with our results in Table XI.

TABLE XI.

	Formol-toxoid					Alum-precipitated toxoid		
	Ramon and Zoeller (1933) (a)	Sacquépée (1933) (b)	Hall (1937) (c)	Sneath and Kerslake (1934) (d)	R. A. M. College (e)	Bergey and Etris (1936) (f)	Gold (1937) (g)	Hall (1937) (h)
< 0·01		6	—	3	—	—	—	—
0·01 to < 0·1		107	11	6	3	—	1	—
0·1 to < 1	Most cases	126	1	20	21	14	13	12
1 and over	A few cases	1	—	—	6	16	4	1

(a) Exact numbers not quoted. 1st dose, 1 c.c.; 2nd dose, 30 days later, 1·5 c.c.; 3rd dose, 10 to 15 days later, 1·5 c.c.; tested about 1 month later.

(b) 1st dose, 1 c.c.; 2nd dose, 20th day, 2 c.c.; 3rd dose, 30th day, 2 c.c.; tested about 6 months later.

(c) 1st dose, 1 c.c.; 2nd dose, 6 weeks later, 1 c.c.; 3rd dose, 2 weeks later, 1 c.c.; tested 6 weeks after 3rd dose.

(d) Dosage and test as in (a).

(e) 2 doses of 1 c.c. at intervals of 6 to 7 weeks. Tested about 1 month later.

(f) 2 doses of 1 c.c. of alum-precipitated toxoid separated by an interval of some months. Tested 1 month after 2nd dose.

(g) 2 doses of 1 c.c. of alum-precipitated toxoid at intervals of 92 days. Tested from 7 to 15 days after 2nd dose.

(h) 2 doses of alum-precipitated toxin at an interval of 6 weeks. Tested about 6 weeks after 2nd dose.

From these it can be seen that inoculation with two doses of tetanus toxoid, given at an interval of six weeks or slightly over, has produced an antitoxin titre which is equal to that given by the three-dose method as advocated by Ramon and his colleagues and widely practised in France and elsewhere.

Ramon and Zoeller, early in their investigations, found that the first dose of toxoid produces little or no antitoxin in the serum, but results in the development of a remarkable aptitude for antitoxin production when further doses of toxoid are administered. This is generally believed to be due to a sensitization of the cells of the reticulo-endothelial system, which become "shadow-factories" of antitoxin ready to function when the appropriate stimulus is applied. Figures given by Ramon and Zoeller (quoted at an earlier point in this article) show the gradual development of this sensitization up to a month from the original dose. In our trials a gap of a further two to three weeks was given, and there is evidence of a further well-marked increase in reacting power. Ramon's first and third doses are given at approximately the same interval as our first and second doses, and the final results are so similar that it would appear that an intermediate dose, given during the period when sensitization is developing, has little or no action in enhancing the final titre of antitoxin.

There is no evidence to show that six weeks is necessarily the optimum interval between doses, and it is possible that with wider spacing better results might be achieved. In practice, however, too long a gap between doses has its disadvantages, and the titres obtained when the two doses are six weeks apart are believed to be sufficiently high to attain their object.

Three similar sets of results following inoculation with alum-precipitated toxoid, which have already been discussed, are also summarized in Table XI. In one case where the interval between doses was much longer than in the other experiments quoted, the average titre is higher; in the other two, with an interval of six weeks and three months respectively, the results are very similar to those given by formol-toxoid.

It is proposed to make further experiments with alum-precipitated toxoid as an immunizing agent, but it is anticipated that, while this may produce a higher average titre than does formol-toxoid, any advantage which this may confer may be counterbalanced by such matters as local reaction, the necessity for awkwardly long intervals between doses, and the greater difficulty involved in turning out this preparation in bulk.

### Practical Application.

This work was undertaken at the suggestion of the Director of Pathology to explore the possibility of introducing active immunization against tetanus as a routine measure in the British Army. The standard of immunity attained with the well-spaced two-dose system compares favourably with that achieved by other methods, and is believed to be adequate to confer protection for a considerable period of time. Recommendations have accordingly been made, to introduce this measure on a voluntary basis. Instructions on the subject, including the question of combined inoculation with T.A.B. vaccine and tetanus toxoid, will be issued in due course.

## Summary.

(1) Inoculation with tetanus toxoid-antitoxin floccules produced negligible quantities of antitoxin in the serum but, as proved by reinoculation with toxoid nine months later, established a satisfactory basal immunity.

(2) Inoculation with two doses of 1 cubic centimetre of tetanus toxoid, given at an interval of six weeks, produced a concentration of antitoxin in the serum far above the level necessary to confer protection against tetanus. The results compare favourably with those from Ramon's three dose method, and also from inoculation with two doses of alum-precipitated toxoid, except when these are administered at very wide intervals.

(3) Neither floccules nor toxoid produce a general or a local reaction.

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*Note.*—References have been mainly confined to the more important publications in English and French. Similar results have, however, been recorded from other countries, and the literature on the subject is voluminous.

## THE LABORATORY CONTROL OF TETANUS PROPHYLAXIS

By A. T. GLENNY

AND

MURIEL F. STEVENS,

*Wellcome Physiological Research Laboratories.*

ANY prophylactic intended for human immunization must satisfy two requirements, it must be harmless and it must be antigenically efficient. The methods of attaining these requirements described in this paper are based upon our experience in testing toxoid used in the preliminary immunization of horses or for the production of alum precipitated toxoid that we have used to protect many thousands of horses against accidental tetanus.

Tetanus toxoid chosen for human use is prepared from toxin with an L+ dose of 0.03 cubic centimetre or less (against 0.2 International unit). The flocculating power of the toxoid must not have decreased by more than 10 per cent during toxoiding. The Lf dose of the original toxin and of the toxoid is preferably determined against two control sera with widely differing non-specific zones. Non-specific zones are encountered far more frequently with tetanus than with diphtheria antitoxin, and special precautions must be made to avoid misleading results.

There is incontestable evidence, in the case of diphtheria toxoid, that neither the flocculation value (Lf) nor the time of flocculation (Kf) gives a true index of the antigenic efficiency of the toxoid. Therefore it is necessary to test toxoid by its immunizing power in guinea-pigs. The extent to which test animals have been immunized can be determined by testing either their tolerance for toxin or the antitoxic content of their blood. No form of Schick or multiple Schick test is available for tetanus, and tolerance tests must be made by injecting a definite number of lethal doses. Since each animal can be used for only one test at one level, a very large number of animals would be needed to form a quantitative estimation of the immunizing power of the toxoid. The method can, however, be used as a means of determining that the prophylactic satisfies some minimum requirement of antigenicity. The titration of the antitoxic value attained by immunized animals is a more satisfactory method; we therefore bleed the animals, which have had the 5-cubic-centimetre amounts subcutaneously, six weeks after the injection. The sera are tested individually at first to obtain an approximate value of the antitoxin, i.e. over or under 0.2 unit, and subsequently for over 2 units and under 0.02 unit. They are then bulked into groups according to the values and a more accurate determination of the antitoxic content is made. This method is adopted because, owing to the scatter of values, pooled sera may give misleading

results if they are bulked without any knowledge of the titre. The best index of antigenic response is the geometric mean of antitoxic values reached. A titration of sera pooled in equal volumes gives the arithmetic mean which differs widely from the geometric mean unless the individual values differ over a narrow range. The geometric mean of titrations of pools of sera already divided into narrower ranges gives a figure nearer the true figure derived from testing each individual serum. It is also expensive in time and mice to test individual sera fully, and the bulking method has the additional advantage in that there is a larger quantity of material with which to do the titrations. The antigenic values of a number of average toxoids tested by this method are given in Table I. The results are given

TABLE I.—SHOWING THE RESPONSE OF GUINEA-PIGS TO A SINGLE INJECTION OF 5 C.C. TETANUS TOXOID BASED UPON THE ANTITOXIC VALUES OF SERA TAKEN SIX WEEKS LATER.

Toxoid	Original toxin		Toxoid  Lf per c.c.	Antitoxic value of serum pooled according to preliminary test.					
	L+ in c.c.	Lf per c.c.		Under 0·02	0·02-0·2	Over 0·2	0·2-2·0	Over 2·0	Geometric mean
283	0·03	4·0	3·5		0·08 (4)	2·0 (8)			0·683
264	0·028	4·5	4·5		0·2 (3)	1·0 (9)	2·0 (3)	4·0 (7)	1·37
263	0·02	6·5	6·0		0·04 (6)	2·0 (15)			0·654
265	0·02	7·0	7·0	0·002 (1)	0·07 (3)	1·0 (6)			0·242
254	0·013	9·0	8·0		0·2 (2)	4·0 (7)			2·05
362	0·012	11·0	10·0	0·005 (5)	0·04 (4)	0·4 (8)			0·064

The figures in brackets indicate the number of guinea-pigs.

in terms of International units, although the tests were done using 0·1 American unit as a standard, one American unit being equivalent to two International units. In many instances individual sera containing more than 0·2 unit were not tested at a higher level, and sera with a wide range of values were thus pooled together. The geometric means recorded can therefore be regarded as only a rough approximation of the antigenic efficiency of the toxoid. It is obvious, however, that batches of toxoid can vary greatly in their immunizing power independently of their combining power for antitoxin (e.g. Lf value).

#### ANTITOXIC VALUE OF SERA.

Mice are used by us in preference to guinea-pigs for the titration of tetanus antitoxic sera. The test dose of toxin is that quantity which, when mixed with 0·2 International unit, will kill a mouse in from seventy-two to ninety hours after injection. The mixtures are left for one hour at room temperature and then injected subcutaneously into mice near the base of the tail. Except in the case of pooled guinea-pig sera very little material is available so that only 0·1 cubic centimetre of serum can be spared for each test. This amount of serum protects, or fails to protect, a mouse against one test dose of toxin according to whether the serum contains more or less than 2 units per cubic centimetre. Should the serum contain

more than 2 units per cubic centimetre succeeding tests are made with less than 0.1 cubic centimetre of serum until the required end-point is reached. If, however, the antitoxic value is less than 2 units per cubic centimetre it is necessary to reduce the amount of toxin used in each titration, and mice are injected with a series of mixtures containing 0.1 cubic centimetre of serum and a fraction of a test dose of toxin. When testing for low values of antitoxin it is essential to use a toxin containing a relatively large number of M.L.D.s per L+ dose (i.e. with very little toxoid present). This is found with a short growth (two to three days) toxin, and we have used one which had been dried and was subsequently made up in 50 per cent glycerine solution. The test dose was contained in 0.065 cubic centimetre of this solution. One-thousandth of this amount will kill mice within four days. With so many fatal doses in the test dose fractional titrations can be made. When using any dose of toxin from the test dose to one-hundredth of this amount there is a fairly constant relation between the amounts of toxin and antitoxin present in a mixture killing a mouse in the prescribed time. With less toxin the end-point of survival with symptoms of tetanus must be taken. One-ten-thousandth of a test dose will produce symptoms without death, and roughly 0.00002 unit will protect a mouse from the appearance of tetanus. That the test at the 1/10,000 level is only approximate is due to the avidity of the sera. We have shown by dilution of known avid and non-avid sera that for an avid serum proportionally more toxin is needed at the 0.001 unit level, to produce the same end-point in mice, than is required at the 0.1 unit level, whereas for non-avid sera the reverse is the case. In the latter instance there is considerable dissociation of the loosely combined toxin and non-avid antitoxin at the high dilutions. Avid sera do not dissociate and the free toxin, as the dilutions increase, is naturally diminished. Thus no exact values can be allotted from titrations with small fractions of a test dose; but no practicable service is gained by titrating guinea-pig or human sera to exact values. We have been satisfied to record a serum as containing say 0.1 unit if the value is found to be greater than 0.1 and less than 0.2 unit per cubic centimetre.

#### SUMMARY.

A method is described for testing the immunizing power of tetanus prophylactics and for the antitoxic titration of small quantities of human sera.

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## THE PREPARATION OF FORMOL TOXOID AND ALUM PRECIPITATED TOXOID.

By J. G. C. CAMPBELL, B.Sc., DIP. BACT.

*Wellcome Physiological Research Laboratories*

To produce tetanus toxoid, *Cl. tetani* is grown in broth containing Witte peptone for a period of from five to fourteen days; the optimum period for harvesting is dependent on the strain and is determined by frequent examinations of the filtrates from the cultures by means of the flocculation test. The toxin has an L+ dose in mice of 0.02 to 0.012 cubic centimetre and an Lf value of 5 to 8. The cultures are filtered through Berkefeld "N" candles after preliminary clarification through paper pulp, 0.3 per cent of formalin (= 40 per cent formaldehyde) is added to the filtrate and the latter is incubated at 37° C. Toxoiding requires about three weeks, and is regarded as complete when 5 cubic centimetres injected subcutaneously into a guinea-pig produces no symptoms of tetanus; the animal is kept under observation for three weeks before the toxoid is finally passed. The toxoid is submitted to the sterility tests prescribed by the Therapeutic Substances Act; and also to a special series designed to detect the presence of *Cl. tetani*.

Further preparation of the toxoid is carried out in a room remote from the building in which the cultural work is carried out. Here it is again filtered through Berkefeld "N" candles, filled into containers, and submitted to the T.S.A. tests.

Alum precipitated toxoid is prepared from the formol toxoid described above. Preliminary tests are made to determine the optimum amount of alum required, by adding varying amounts of the latter to a fixed amount of toxoid; when the precipitate has settled, the supernatant fluid is tested to determine the presence or absence of toxoid; and from these results is obtained the smallest quantity of alum required to completely precipitate the toxoid.

The necessary amount of potash alum is added to the bulk of the toxoid; the two are thoroughly mixed, and allowed to stand overnight. By the morning the precipitate containing the toxoid has settled; it is adequately washed with saline and sodium phosphate and antiseptic added. The solutions used for the washing process are previously sterilized by autoclaving and the operations are carried out aseptically. The final product is tested for sterility by the official tests and by the additional special anaerobic tests as used for formol-toxoid. If satisfactory, it is filled into containers and again sterility-tested before issue.

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## FEVERS OF THE TYPHUS GROUP IN THE BHIM TAL AREA, KUMAUN HILLS, U.P., INDIA.

BEING A REPORT OF AN INVESTIGATION CARRIED OUT INTO THE  
ALLEGED INCIDENCE AND NATURE OF TYPHUS GROUP FEVERS IN  
THE BHIM TAL AREA, KUMAUN HILLS, JULY, 1936.

BY CAPTAIN BASIL BLEWITT,  
*Royal Army Medical Corps.*

(Continued from p. 245).

### DISCUSSION.

The salient features in connection with the incidence of alleged typhus-group fevers in the Rhim Tal Valley have been reviewed. Megaw's *prima facie* case against the tick as a vector has been subjected to experimental tests and the results noted. It remains to weigh carefully the evidence which has accrued before conclusions can be drawn as to its validity in the past or to its applicability to the present.

#### I.—WHAT WAS THE NATURE OF THE FEVER DESCRIBED BY McKECHNIE AS TYPHUS?

A perusal of the details leaves no room for doubt that the fever was either typhus or an enteric group infection. As regards the latter with its protean manifestations, the clinical picture cannot be regarded as definitely eliminating it. It must be admitted, however, that the clinical syndrome is more in conformity with a typhus infection. Confirmatory laboratory results would be essential to justify an enteric diagnosis. These are not forthcoming and, on the contrary, are definitely against such a diagnosis. It should be remembered, however, that the Widal's of that time were not arranged to detect the significant "O" agglutinins of enteric infections and Felix and Felix and Clitxky (Topley and Wilson, 1929) have shown that a high percentage of such cases only produce "O" agglutinins. While this is true of the individual case it could hardly apply to all cases in a given epidemic such as McKechnie's series; and there are no published records of such occurrences. The negative Widal's in McKechnie's cases must, therefore, be regarded, despite the discrepancy, as eliminating an enteric group infection which is further confirmed by the completely negative blood cultures.

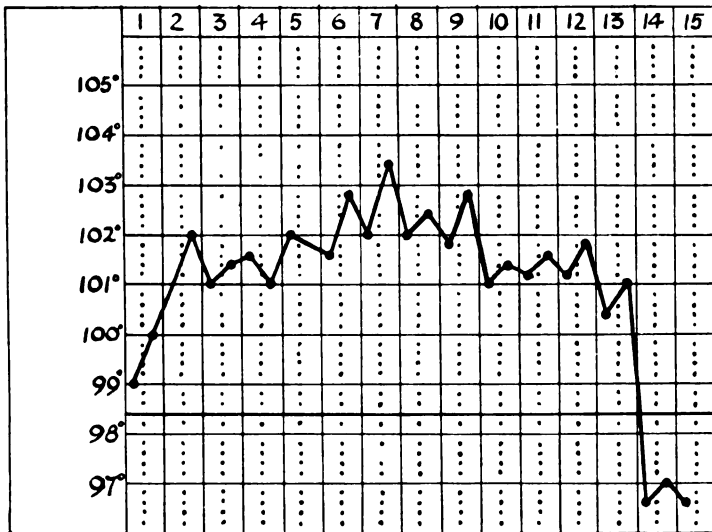
The alternative diagnosis is typhus. There is nothing against this diagnosis and there is everything for it. Firstly, it conforms closely with the accepted clinical picture—the type of the fever, the rash, the marked stupor, the extreme and early prostration. Secondly, it occurred in a population which presented every feature necessary for the outbreak of a louse-borne disease. This will be discussed later in these studies. Sufficient it is to say that this was clearly McKechnie's view—he mentioned the louse as a possible vector. His reference to the possibility of fleas and bed bugs

being in deference to his views on the epidemiology as affected by the European incidence.

As regards the nature of the fever one must at least agree with McKechnie that it was typhus and not an enteric infection.

II.—DO THE EPIDEMIOLOGICAL FACTORS OF THIS TYPHUS JUSTIFY MCKECHNIE'S CONCLUSIONS AS TO THE VECTOR OR VECTORS CONCERNED?

Through the valley of Bhim Tal runs the main hill road on its way from Kathgodam to Ramghar and Almora (this is excluding the main motor road through these hills which on account of its circuitous course is little used by the natives travelling on foot or horse through the Kamaun). Through this valley pass the hill people on their annual migrations, as must also all travellers to and from the hills beyond and



Case 2 (McKechnie).—Sat Tal, September, 1913. European gentleman, aged 60. Blood culture, third day, negative. Rash, third day. Photophobia, flushed face, sunken expression, rapid recovery.

Nepal, and the village of Bhim Tal is the last halting place for the downward traffic and the first for the upward. It would thus appear that the area is particularly exposed to the introduction of disease. In particular, however, it is exposed to the introduction of louse-borne diseases in general, and especially to louse-borne typhus by the travellers from the endemic areas further back in the hills and in Nepal and Tibet. It has certainly experienced epidemics of louse-borne disease as is evidenced by the outbreak of louse relapsing fever which McKechnie encountered on his arrival in Bhim Tal. It was proved to have been introduced to Bhim Tal by an itinerant native woman from Haldwani in the plains (Megaw 1922). While there is no doubt that the area is exposed to

these infections there is equally no doubt that it offers all the necessary conditions for the establishment of these diseases in the valley. Firstly the indigenous population are themselves louse-infested, secondly the conditions of hill village life are characterised by dirt and over-crowding, and thirdly there is a temperate climate. It is thus apparent that the district is unusually exposed to louse-borne infections, and in addition offers every condition necessary for them to thrive in.

One may wonder then why McKechnie had any difficulty in diagnosing the nature of the disease. The clinical picture was clear, and in fact it was on this alone that he was eventually convinced that the disease was typhus. Further there was no doubt that the natives were louse-infested, were exposed to louse-borne infections, and were, in fact, just recovering from a louse-borne epidemic. What presented the difficulty was the European incidence—they were not louse-infested nor were any lice found on them. This, then, was the stumbling-block—the feature which he could not adjust with his views on the epidemiology of typhus—this fact and this alone prevented him from accepting the clear-cut picture which the disease in the natives presented. Later, however, he was to readjust his views on the epidemiology and accept what, but for the European cases, left no room for doubt. For reasons to be discussed later it is clear the apparent difficulty with regard to the European patients is only what one would expect, and should, in view of the associated incidence among the natives, have given rise to no difficulty.

As regards the vector involved one may wonder why he felt it necessary to postulate the existence of any vector other than the louse. He tentatively suggested the flea and the bed bug, though there were no grounds whatever to justify such a view, except that these, with lice, are common ectoparasites of man in the hills. It must be noted that the louse is mentioned as a possible vector. His further conclusion that the disease is contracted from contact with the natives is in complete harmony with this view.

There seems no reason to discuss the flea and the bed bug any further at this stage; there is no evidence for them and they are obviously introduced rather timorously in deference to his not finding lice on the Europeans. As such the *prima facie* case for the louse must stand. One must agree with McKechnie as to the nature of the fever and that the louse considered by him as a probable vector was undoubtedly the vector concerned.

### III.—DO THE FEVERS WHICH HAVE OCCURRED IN THE ENSUING YEARS CONFORM IN THEIR CLINICAL PICTURE AND EPIDEMIOLOGY WITH THOSE IN 1913?

In this connection we have eleven cases available for study.

There is a complete conformity in the clinical picture, and we must agree that clinically, at any rate, the diseases are similar.

As regards the associated epidemiological factors. The incidence

reveals a number of sporadic cases scattered throughout the ensuing years and in no way apparently associated with an epidemic among the natives. The natural disinclination of all natives to discuss their illnesses with outsiders must be borne in mind. The incidence among them is usually hidden by a wall of suspicion, or all fevers are spoken of as malaria until matters assume major epidemic proportions. Then, and only then, is the wall of suspicion removed, and the observer may catch glimpses of disease which previously were unrecorded and unsuspected. This is particularly true among the natives of comparative hinterlands like the Kamaun. Further it is apparently characteristic of epidemics in the hills that they are usually confined to one or more huts and rarely assume major epidemic proportions. Again the position of the villages, out of the beaten track, does not facilitate systematic routine inquiries such as are carried out in the more civilized communities. Bearing all these facts in mind it seems not improbable that minor typhus epidemics have frequently occurred and passed unnoticed. Whether this is true or not, it is certain that sporadic cases among the natives have occurred and it is on record that one of the fatal cases in a European was associated with the disease in a native (Banerjee 1927). In discussing this and another case he remarks: "I could find no clue to the source of infection in the first case, in the second (Sharp) a daughter of an Indian employee of the patient's had typhus just before his illness."

These remarks are not only notable for the light they throw on the possible ætiology of Sharp's attack, but in the support it gives to the contention that sporadic cases occur among the natives and are only noted in exceptional circumstances—e.g. the fatal attack in a European—and the presence of a distinguished observer on the spot to make inquiries.

As regards seasonal incidence, and close contact of the cases with louse-infested natives, there is complete harmony between the more recent cases and those of 1913.

It seems reasonable to assume, therefore, that while the epidemiology differs from that of 1913 in the absence of a recorded epidemic among the natives in association with the cases, yet there is considerable reason to believe that minor epidemics may have been so associated with the European incidence. If this is true, and it seems the reasonable explanation bearing in mind our knowledge of the 1913 outbreak, and the susceptibility of the area to such infections, it follows that the differences in the epidemiology is one of degree rather than any essential change. It seems reasonable to accept, therefore, that the clinical and epidemiological picture associated with more recent cases are essentially the same as in McKechnie's time.

*(To be continued.)*

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## IMPROVISATION AND PRACTICAL WORK IN CAMP.

## A FEW HINTS TO JUNIOR R.A.M.C. ADJUTANTS.

BY MAJOR J. H. BAYLEY, M.C.

*Royal Army Medical Corps.*

WHILST acting recently in the capacity of R.A.M.C. Adjutant to a Territorial Division, I was exercised in my mind as to how to maintain interest and keenness in the two Field Ambulances I was responsible for training. The men came down to the annual camp full of zeal and enthusiasm which tended to evaporate when the usual routine training of drill, stretcher drill, marching, loading strange hired lorries and vans with technical equipment, pitching tents and marquees, etc., finally culminated in the construction of an A.D.S., with the usual method of collecting casualties from R.A.P.s and evacuating them to the M.D.S. This exercise was cut and dried, and essential as it was, it ceased to have the interest it should, because of repetition; the only unknown quantity was a change in the terrain due to the different camp sites occupied by the units each year.

I felt one missed the realism of an advance and retreat with actual troops employed in a scheme. It was difficult enough to obtain casualties from a friendly unit when we had our own exercises. True we fitted in with battalion field days, but they were too restricted to be of any real value.

Our G.O.C. insisted on unit training and although we were an integral part of a Brigade in camp, not once during my three years were we able to have a Brigade Field Day.

I am not for one moment decrying the type of training carried out by the Field Ambulances; it was and is very necessary, but I felt it should be supplemented, and then some words spoken by one of our Quartermasters came back to me. "The trouble with our Corps is, there's too much bloomin' improvisation." I venture to disagree with that Quartermaster. How many of us, in emergency during the War, were able to surmount a situation which at first glance appeared impossible, merely by improvisation. What is required? A little imagination, a small amount of ingenuity, a modicum of common sense and the resulting mixture is "Improvisation." This is a valuable asset in times of stress and in small doses guaranteed to stimulate interest in training in times of peace.

On your preliminary visit to a camp site with the Quartermaster and a Royal Engineer officer, if you have sufficient time, make a careful reconnaissance of the training ground and the terrain in the vicinity of the camp; if too busy, go down later on your own—the time will be well spent and will amply repay you for your trouble. Adapt and mould your ideas on this reconnaissance; go home and work out a scheme.

I. There may be a fairly large railway station within a few miles and that should have a goods station adjoining. Visit the stationmaster, use a certain amount of tact, gain his interest, enlist his sympathy and explain what you want. I am sure from past experience he will be only too pleased to help.

Turn one of your companies into an entraining unit; consider carefully these following points:—

(1) Road approaches—wide gates—In and Out traffic—traffic police—surface gradients.

(2) Measure the length of platform and ramps, decide how many bogeys can be loaded without shunting.

(3) Cover for loading.

(4) Close road approach; avoid hand carriage.

(5) Never use a passenger station—main lines—interference with the movement of troops.

(6) Water supply for drinking and cooking.

(7) Lighting, dependent upon nearness to the front line and the possibility of bombing.

(8) Latrines.

(9) Two-bedded ward for cases too bad to proceed, i.e. moribund.

(10) Mortuary.

(11) Accommodation for medical officers and personnel.

(12) Cookhouse.

(13) Waiting and refreshment room for sitting cases.

(14) Office.

(15) Small medical store.

(16) Stretcher and blanket dumps.

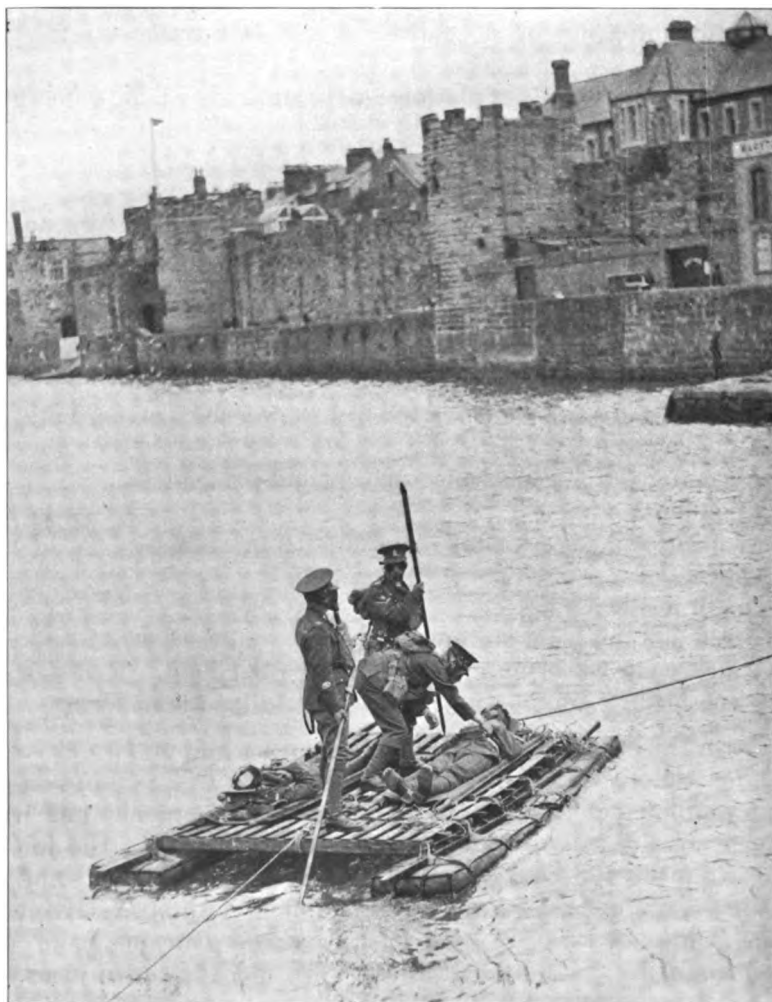
(17) Emergency petrol dump for motor ambulances. Evolve a system whereby the loading and checking of cases entrained is foolproof.

II. Turn the other company into improvising one or two closed goods wagons for the reception of stretcher cases, on the assumption that a temporary ambulance train has to be prepared in emergency and irrespective of the fact that in actual practice it would not be the job of the R.A.M.C. to make the conversion. Beg, borrow or acquire some timber 3 by 2 inches, marquee poles and any amount of lashings. Give the men the general idea of racks to take four stretchers (surplus room will be occupied by sitting cases) and let them work out their own ideas. Competition will be keen and a word of praise will go a long way. Actually load stretcher cases on to the racks to demonstrate difficulties.

III. If your camp is situated near a harbour and there is an empty coastal ship, small freighter or passenger ship, get in contact with the harbourmaster and the captain of the ship, use some more tact, and if successful turn the two Companies into an embarkation unit—one Company occupying a small warehouse or shed at the harbour entrance as a small

A.D.S. where motor ambulances *en route* call in case any occupant needs re-dressing.

Arrange : Traffic police. In and Out traffic. Routes. A foolproof system of checking cases embarking. Actually have nominal rolls prepared. As only one motor ambulance will be available, use your motor lorries as well. Keep a steady stream of casualties coming in and avoid gaps.



Detail an E.M.O. and place an officer on the ship who will accept and distribute cases as they come aboard. In theory allot the various holds and cabins to the types of cases you have to embark, i.e. medical, surgical, gassed, S.I., mental, etc. The captain may be keen to lower one load of stretcher cases by derrick crane into a hold. Be careful how you accept this offer. You do not want any real casualties.

*Note.*—If gangways are narrow, two close together are easier for four stretcher bearers to negotiate a stretcher case. Be sure to have another gangway further along for returning stretcher bearers.

IV. The improvisation of a hay-wagon by means of timber and lashings to take slung stretchers is perhaps obsolete in these days of mechanization, so a method I can strongly recommend is the conversion of a thirty-hundredweight or a three-ton lorry into a motor ambulance to take four slung stretcher cases, and in the larger lorry some six to eight sitting cases as well.

An N.C.O. and a private with nothing but horses head ropes and a few light lashings, using a system of loops slung from the roof framework, made an excellent suspension scheme ; with a little practice they managed to complete the improvisation in twelve minutes. Loading at first was a little difficult, but the difficulties were overcome and the result was excellent. I can thoroughly recommend this as a very sound emergency method.

V. The gas proofing of an old room in a farm outbuilding, or if that is not available the construction of a double entrance to a supposed dug-out sufficiently large to take a stretcher and two stretcher bearers. Trees, ropes, marquee poles and tarpaulins help to make the passage, G.S. blankets the falling curtains at the ends. Steel helmets and anti-gas respirators worn by stretcher bearers and patient add a little more realism.

VI. If in the vicinity of a fairly shallow yet broad enough river, assume there is no ford or bridge available. Try transporting stretcher cases across in small boats or borrow a Kapok raft from the Royal Engineers, and put up a smoke screen for added realism. This exercise should be practised again at night ; be sure to select personnel who can swim in case of accident.

VII. Try to get the Royal Engineers or infantry to construct a demonstration trench and point out to the stretcher bearers the difficulties of getting a loaded stretcher along, particularly when the trench is manned.

#### PRACTICAL WORK.

(a) Night operations are not popular ; one has to remember that it is the men's annual holiday as well as Camp. Evenings are therefore given up to social entertainment. Nevertheless, I feel the surrender of one fine evening would not be begrudged, and the lessons learnt are invaluable.

Select sites for R.A.P.'s.

Select sites for relief posts ; to each of these apportion squads of stretcher bearers.

Select a site for a car-loading post.

Select a site for a bearer post commanded by a bearer officer.

Ensure that these sites are not too easily reached.

Select four men who will eventually act as guides, one to each R.A.P.

In your original reconnaissance make accurate map references of each site for the bearer officer.



Take your guides up, one by one, to each R.A.P. ; make use of all cover and point out each relay post *en route*. Just before dark send out squads to occupy their original positions. When darkness has set in carry out a complete relief of stretcher bearers. March your men to the bearer post and then each guide takes his relief party of stretcher bearers to his particular R.A.P., and when they reach there the relieved stretcher bearers can be brought back as casualties. This operation is to be carried out in silence, no smoking, no lights. Post umpires at various spots and award marks for the first relief carried out in the shortest time and casualties brought in successfully. It is surprising how difficult known routes become in absolute darkness. If a few Very lights can be put up in the supposed enemy line, it will give added realism. The night may be dark but umpires will probably report some illuminating language.

(b) Map references have been made of previously reconnoitred R.A.P. positions.

Select eight N.C.O.s and send them out in pairs ; their task is to make a reconnaissance of these positions, select sites for relay posts down to a car collecting post, and bring back a sketch plan to scale showing their schemes and routes taken. At a given hour all are collected, results are read and friendly criticism and help given.

The word "criticism" makes me realize that much may be levelled at this article and particularly at my assumption of unusual duties for a field ambulance. My reply is to quote a very true but little known definition : "A Field Ambulance is that unit which has an infinite capacity for being badgered about." My apologies to that very senior officer who may read this and whose definition I have borrowed.

The points I would emphasize are :—

- (1) Careful reconnaissance.
- (2) Very careful consideration in the building up of the scheme. Adapt it to the ground and circumstances (not vice versa).
- (3) Enter fully into every detail beforehand.
- (4) See that every officer has some job, and at a conference beforehand understands the whole scheme.
- (5) Introduce as much realism as possible.
- (6) A carefully considered plan worked out in detail is bound to succeed.

If these sketchy notes should be of assistance to any harassed young adjutant, then my time has been well spent. I can assure him he will get increased keenness and enthusiasm in his unit, and so "Good Luck and Good Campin'."

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## THE PROBLEM OF MECHANIZATION AS IT AFFECTS THE MEDICAL SERVICE.

BY LIEUTENANT-COLONEL R. R. G. ATKINS, M.C.,  
*Royal Army Medical Corps.*

MECHANIZATION in the Army has advanced considerably since its inception. Trials have been made, defects found and rectified. Tests with the different arms have shown the effect of mechanization on the organization, administration, and fighting of a unit.

The Royal Army Medical Corps must needs wait for a definite mechanized organization of the Army before it can decide whether the present field medical organization will be suitable.

In what follows I have given some of the effects of mechanization, and made suggestions as to how it might affect the present medical arrangements for war.

Mechanized forces are of two general types: (i) A completely mechanized fighting force; (ii) a motorized force, carried in vehicles with mechanical transport.

There are certain rules on which mechanization is based, these are: (i) A "peace-time" standard engine and chassis must be adopted. (ii) As few types of vehicles as possible must be used. (iii) Road-space between vehicles takes up room on the road; therefore each vehicle should be as big as is consistent with its rôle. (iv) The efficiency of a unit depends on its absolute mobility. Therefore: (a) No equipment should be carried that is not essential; (b) "B" echelon must be as small as possible; (c) the number of vehicles in any unit must be cut down to a minimum consistent with efficiency.

Mechanization leads to road congestion, and this is liable to be increased by the present organization of the Army which has been adopted to allow the weight of a force to be swung on to the decisive sector.

Road congestion, causing a slowing-up or even leading to complete immobility is a factor that can counteract mechanization, and might have very far-reaching effects on the success of a campaign.

Every unit "mechanizing" must take two factors into consideration: (i) Whether mechanization of other units produces new factors which will have to be catered for; and (ii) whatever organization is adopted, as few vehicles as possible must be put on the road.

Mechanization produces the following new factors which alter the medical problem. These are: (i) Units may be employed on a wide front, in contradistinction to a contracted one; (ii) the range of action of a unit is increased; (iii) manœuvre will, in some cases, be more rapid; (iv) one or more units may be separated from the main force by a considerable

distance and the intervening ground may or may not be protected ; (v) a raid to some distance may take place into enemy country ; (vi) many moves will be by night.

As units are responsible for collecting their own wounded, when deployed on a wide front, hand carriage by regimental stretcher bearers would be too tiring and slow. Transportation of wounded ON WHEELS WITHIN A UNIT WILL HAVE TO BE ARRANGED FOR.

If manœuvre in action is rapid, unless wounded are to be left unattended for a long time, collection and grouping of wounded will have to take place quickly. Unit stretcher bearers know where casualties have occurred. The stretcher bearers must accompany their unit on the next bound, otherwise they would have great difficulty in locating their unit and at night they would not find it. If, under these circumstances the collection of wounded is left to field ambulance bearers, it will involve a long and difficult search of the area and precious time will be lost.

This again brings us to the fact that carriage of wounded on wheels within a unit will have to be adopted.

When units are separated from the main force by unprotected ground the same fact is again apparent. In the past cavalry have often had to abandon their wounded. Mechanization has given us the means of preventing this, so let us make full use of this new factor.

The first medical problem is therefore to arrange some form of wheeled transport with which a unit can collect the wounded, and, if necessary, retain some of the wounded with the unit.

This could easily be done when we realize that the unit stretcher bearers have to be carried on wheels. A motor ambulance should therefore be provided as the normal means of transport for a certain number of the regimental stretcher bearers.

The type I visualize is a car with a light low body which could lie up behind hedges, "hull down," without being seen. The chassis would be the ordinary 30 cwt. platoon truck, and would take three stretchers side by side. It should not have a red cross on it. The stretcher bearers, when this was in use as an ambulance, would be carried in the seats of other vehicles previously occupied by the killed or wounded.

A similar type would be the "light" ambulance for field ambulances.

A motor-bicycle side-car stretcher, if adopted, would also be of great use. It would go as far forward as possible, and when used over short distances at a slow rate, acting as a feeder to the unit ambulance, it would answer the unit problem of collecting and grouping wounded quickly.

#### THE MOTOR-BICYCLE SIDE-CAR AMBULANCE.

This is not a new idea as they were used in France during the Great War by two British ambulance sections attached to the French Army, i.e. Section Sanitaire Anglais, Nos. 2 and 5.

The first model was introduced by F. Fox, of No. 5 S.S.A., as he found

it impossible to get motor ambulances anywhere near the line owing to the nature of the country. This was in the Vosges mountains where roads and tracks were similar to the hill station roads and paths in India. In the winter these were covered with snow and ice. This model proved such a success that he formed a unit of thirty such machines. This was at the end of 1915; it is interesting to note that twenty-four of these machines came back to Havre at the end of the war, and four were brought to England. The whole twenty-four were sold in good running order. No. 2 S.S.A. also adopted these side-car motor-bicycle ambulances under D. Preston. These were working on the Oise Sectors, similar to those occupied by the British Army. General Gamelin (now holding the corresponding position in the French Army to our C.I.G.S.) said of these units: "The convoys have done magnificent work. A great number of lives have been saved by the expeditious way in which these cycles have enabled the Medical Services to get their wounded into hospitals early."

The French Army asked for fifty more. These were being arranged for when the Armistice came. One may question why more of these machines were not asked for earlier. It was only after the big German offensive of 1918 that the French fully realized their value. In front of the Oise the French retreated for four days after a heavy bombardment of all roads. These cycle ambulances were the only form of motor vehicle which could get forward. They acted as feeders to ambulance cars and they cleared 1,700 stretcher cases during these four days of retreat, when all roads were very badly broken up. Surely this record speaks for itself.

The following is a résumé of questions addressed to F. Fox and D. Preston, and the answers which they were kind enough to give.

Q.—Did you experience troubles from breakages of the side-car chassis.

Ans.—"The first model broke continually, but I soon found the weak points and I had these fitted with pinned-in steel linings. Our final model never broke and stood up well to real rough usage."

Q.—Do you think the wounded were jolted more than in a motor ambulance.

Ans.—"No. They were just as comfortable, if not more so, but the driver must have the interest of his patient at heart and regulate his pace according to road surface. The patient is happier going feet first as he can see where he is going. In a car, especially on the top shelf when going down hill, he is standing on his head so to speak." (M. Preston adds) "I have driven both cars and bicycles. In cars men often scream, as they are shut in and can hear shells bursting; they also imagine that you are bumping them unnecessarily when the going is bad. I have never heard a man scream in a cycle. There is personal contact between driver and patient as you can talk to him. He can see what is going on around him. Surely the lessening of the added mental terror must mean that when he arrives at a C.C.S. he is in better condition for an immediate operation." (This is a factor which I had not previously thought of and I give it due weight.)

*Q.*—What about the exposure of a case on a cycle?

*Ans.*—"The case is also exposed on a hand-carried stretcher and you get him back more quickly by cycle. Quicker movement through the air does cool him down, so we always carried small metal hot-water bottles. Some machines were enclosed with a hood clamped on to the stretcher. Men invariably asked to have, at any rate, a part of it open. Our later models had side windows."

*Q.*—Did you take sitting cases en-pillion?

*Ans.*—"Yes. We had a special seat constructed and whenever possible made a point of carrying pillion wounded. The weight gave an added grip to the back wheel in mud, snow or ice."

Advantages of a motor-bicycle side-car stretcher : (i) Rapidity of evacuation, except in very forward and exposed positions, when acting as a feeder to a motor-car ambulance ; (ii) saves stretcher bearers ; (iii) low initial cost ; (iv) economical to run ; (v) very easily manœuvred ; (vi) easy to extricate if ditched ; (vii) capable of travelling over tracks impracticable for cars ; (viii) "contact" with patient ; (ix) sprung for the weight it will be carrying (a car ambulance is sprung for ten or twelve people, a load it is not carrying when seriously wounded are being carried) ; (x) road blocks : (a) by traffic—a motor cycle stretcher would pass where a car ambulance could not ; (b) cratered roads—a motor cycle can be wheeled around the edge, the side-car wheel "floating" over the crater ; (xi) single cases could be collected more economically by a cycle than a car. The R.A.M.C. orderly sitting pillion.

Disadvantages : (i) Unless specially protected, wounded would be liable to be more exposed. (ii) Not suitable for cases which struggle ; usually chest cases, or certain types of gas poisoning. (iii) More vehicles on the road.

The Royal Army Service Corps tried out motor-bicycle side-cars some years ago, but did not continue their use as the chassis continually broke. In view of the model produced in 1915 by F. Fox, which did withstand rough usage, I cannot see why, in 1937 the same cannot be achieved. In fact, it is obvious that a useful model could easily be produced by a large scale manufacturer, which would be a standard production.

There are certain points in design which would have to be catered for. These are—

(i) The position of stretcher should be regulated so that a stretcher suspension bar would not interfere with the handle-bars.

(ii) Full protection from splash, in case one drove over mustard contaminated ground. This should include the under surface of the stretcher and spare wheel.

(iii) A portable cover for the patient to be clamped on to the stretcher, to be made of gas-proof material.

A portable and collapsible wheeled stretcher would be most useful in forward areas. A model is being made, and will shortly be presented, in

which the axle breaks in the middle so that each stretcher bearer carries half the wheeled stretcher as well as the stretcher.

The medical organization I suggest for an infantry battalion or corresponding unit is :—

One light motor ambulance.

Two motor-bicycle side-car stretchers.

Four portable and collapsible wheeled stretchers.

Tank battalions and armoured car regiments would not require the wheeled stretchers.

If this organization was adopted wounded could be grouped or brought rapidly to a R.A.P. from any scattered area, i.e. either a long front or from a position held in depth. In the above cases the R.M.O. would be some distance back so as to be more nearly equi-distant from each flank, or at the back of a position held in depth. In most cases this would mean better protection and accommodation, and consequently better treatment.

This provision of special unit vehicles for the carriage of wounded would allow of a few seriously wounded being carried with the unit until they could be transferred to a field ambulance.

#### TO MECHANIZE A FIELD AMBULANCE.

When we consider the rules that apply to any mechanized unit and at the same time take into consideration the new tactics resulting from mechanization, we realize that merely to put the present field ambulance on wheels does not solve the problem.

The type of field ambulance which would suit is a matter for study. I believe that a unit, based on what I am about to describe would be suitable, and furthermore that it would not only be applicable to a mechanized division, *but that it would be a standard field ambulance.*

To realize the points on which this conception is based it is necessary to start on very elementary facts.

Object of a field ambulance : To clear R.A.P.'s of wounded. To administer any necessary treatment and to evacuate them to an operating centre.

Factors which affect the object : There are many factors incidental to the collecting of wounded, etc. but there is only one which I wish to stress here, and that is TIME. The reason for this is, that all wounded which have to be operated on should arrive at an operating centre in sufficient time to have an excision, and either primary or delayed primary suture operation performed. This can only be done if the operation is carried out eighteen hours after the receipt of the wound, and the sooner the better. *In these cases any treatment for the wound other than operation is a waste of time.* The only permissible treatment in front of an operating centre should be : (a) Control of hæmorrhage ; (b) efficient splinting ; (c) treatment for, and for the prevention of shock. (This in some cases means

absolute rest); (d) in gas cases, decontamination, or lying accommodation, whichever is required; (e) suture of sucking chest wounds.

This time factor implies rapid evacuation, *with no unnecessary halts en route.*

All the treatment outlined above *can be done at one dressing station—so why have two?* A wounded man should pass through *one dressing station only.* This is only possible by making full use of mechanization. A few more miles in a motor ambulance will not make any difference to the average wounded man, in fact, an earlier operation is in his favour.

As regards the field ambulance; this means less equipment *and, all important, fewer vehicles.* It also implies a reduction of personnel, so more vehicles are saved and also their provision and upkeep; fewer supplies would have to be brought up. The scheme reacts right through the force from base to front.

More vehicles would be saved by medical officers being carried in box-bodied cars, which would also hold some of the equipment. This equipment would consist of duplicate sets, so that a portion of the unit could be detached if necessary. Say four sets of equipment, any of which could form a small dressing station.

Some of the vehicles saved by this method should be replaced by *ambulances which would form a divisional reserve under the A.D.M.S. This would be in keeping with other arms of the Service under the new organization of the Army, namely, being able to swing the weight of any branch of the Service on to the decisive sector.* M.A.C.'s either in whole or part, would also be attached to this divisional reserve, and would act as field ambulance cars, all cars taking cases from the one dressing station to the clearing area.

The general effect of this idea would be a smaller, more compact and highly mobile unit, which would rely on rapid evacuation rather than on treatment. The essential treatment would always be given.

One can visualize situations where two dressing stations are essential, e.g., when a dressing station has to "leap-frog" before it is clear of wounded. One or more of the duplicate sets of equipment would be sent forward to form the new dressing station. Occasions might also arise where extra medical equipment would be required. These would be exceptions and could very easily be arranged for. One can imagine a force getting out of touch with its advanced hospitals. This should be foreseen, and a light section of the C.C.S. prepared to meet the situation. These exceptions should not, however, be allowed to interfere with the general idea of the field ambulance.

As much as possible of the bulky equipment should be converted into folding patterns. G.S. panniers with contents more or less loose are not economical. Tents, when carried, could be packed flat and carried on the roofs of lorries. Our great-grandfathers packed them in sacks; why should we? Certainly not, unless we have a very good reason for doing so.

Every effort should be made to reduce packing space, in an endeavour to meet the most urgent need of mechanization—to get as many vehicles as possible *off* the road.

It would be impossible to forecast the actual saving in vehicles by this suggested organization.

A rough estimate of the saving in vehicles is seen in the following table:—

	H.Q.		"A" Coy.		"B" Coy.		Total			
	Old	New	Old	New	Old	New	Old	New	Saving	Added.
Motor cycles .. ..	3	3	1	—	1	—	5	3	2	
Cars, 2-seater .. ..	3	2	1	—	1	—	5	2	3	
Cars, 4-seater .. ..	1	1	1	—	1	—	3	1	2	
Lorries, 30 cwt... ..	5	3	4	—	4	—	13	3	10	
Officers' Mess, 30 cwt. ..	1	1	—	—	—	—	1	1		
Artificers, 30 cwt. ..	1	1	—	—	—	—	1	1		
Lorries, 3 ton .. ..	1	3	1	—	1	—	3	3		
Water tank .. ..	1	2	1	—	1	—	3	2	1	
Ambulances, heavy ..	8	2	—	—	—	—	8	2	6	
Van, 12 cwt., dental ..	1	—	—	—	—	—	1	—	1	
Motor-bicycle side-car ambulance	—	2	—	—	—	—	—	2		2
Ambulances, light ..	—	2	—	—	—	—	—	2		2

Total saving in Division Saving 21 vehicles  
per Field Ambulance  
 3 Field Ambulances at 21 = 63 — 28 (A.D.M.S. Reserve) = 35 vehicles

A.D.M.S. Reserve		Old	New
Ambulance, light .. ..		—	6
„ heavy .. ..		—	20
12 cwt. dental van .. ..		—	2
Total .. ..		—	28

It will be interesting to see if there are other officers in the Corps who have ideas on "mechanization," in which case some useful correspondence may result.



## Editorial.

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### CANCER.

THE Fourteenth Annual Report of the British Empire Cancer Campaign was presented at a meeting held at the House of Lords on November 30, 1937. The Grand Council then stated that His Majesty the King, who was President of the Grand Council for twelve years, had consented to become the Patron, and the Duke of Gloucester had agreed to take His Majesty's place as President.

The influence of the Campaign has been extending not only throughout the British Empire, but throughout the world. An international body, the Union Internationale Contre le Cancer has recently been formed and the Campaign is now represented on its Council. At the first Congress held under the auspices of the Union an award for conspicuous merit in cancer research was made to Professor Kennaway and Professor Cook, whose work at the Research Institute of the Royal Cancer Hospital has been assisted by grants from the Campaign.

Work on the virus theory of cancer has been assiduously pursued during the year under review and investigations have been directed to the study of the Shope papilloma and chicken sarcomata.

In a previous editorial on cancer we referred to the Shope papilloma which occurs as a large warty growth on cotton-tail rabbits and usually maintains a benign character. If, however, the virus is inoculated into the skin of the domestic rabbit a rapidly growing papilloma appears which becomes malignant if the rabbit lives for sufficient time. The virus can be recovered from the domestic rabbit only with difficulty, and so far without success from the malignant tumour. The regularity with which malignancy occurs in the inoculated domestic rabbit leads to the conclusion that the carcinoma is the direct result of the action of the virus on the epithelial cells of the host.

The papilloma virus, like the chicken tumour virus, elicits antibodies which circulate in the blood of the host and can be demonstrated in the serum of domestic rabbits which are bearing the papilloma. This shows the virus is present in domestic rabbit tumours although its presence cannot be easily demonstrated.

Rous has shown that if the ears of domestic rabbits are painted at frequent intervals with scarlet red, which causes only some proliferation of the epidermis, and a cell-free extract of a cotton-tail papilloma is then injected intravenously into these rabbits, within a few days malignant changes are seen in the painted areas. These progress into a squamous cell carcinoma which metastasizes and eventually kills the animals. Since the papillomata produced in domestic rabbits by inoculation of the cotton-tail

virus require at least several months before the onset of malignant changes it appears that the chronic irritation of the scarlet red has produced the changes necessary for the virus to show immediately its carcinogenic properties. The factor of local irritation in this experiment is proved to be a secondary one.

Studies on the nature and size of the particles of the virus of the Rous sarcoma have been made in many laboratories. Jobling and Sproul have recently claimed that the exciting agent of the Rous sarcoma is a lipid substance which can be extracted from the tumour by the usual lipid solvents, such as benzene or carbon tetrachloride. They state that the material thus extracted is inactive if injected alone into fowls, but readily gives rise to tumours if incubated with inflammatory material obtained by inoculating kieselguhr into the breasts of normal fowls. One injection produced a typical sarcoma two or three weeks after this treatment.

Ledingham, McIntosh, and other workers, have shown that the infective agent is readily deposited from cell-free extracts of the tumour by centrifugation. A lipid substance existing as a dispersal phase in an aqueous medium would, on the contrary, tend to rise to the surface of the column of fluid when centrifugal force was applied. The actual size of the infective particles has been shown by centrifugation and filtration to be about seventy  $m\mu$ , and therefore the existence of an independently existing lipid substance as the active agent appears to be untenable.

Jobling's experiments have been repeated. Lipoid fractions were incubated with an extract of inflammatory tissue or incubated with saline, but no significant change occurred in the tumour desiccate. The unfiltered lipid solutions gave rise to typical sarcomata. When the solutions had been filtered through a Berkefeld W filter, or a Seitz filter, the activity of the solutions disappeared completely. The activity was as great after incubation with saline as with inflammatory tissue. It is concluded that the activity of lipid extracts of Rous sarcoma is due to minute traces of the dry tumour material which have been carried into the extract mechanically.

Dr. Pollard at the Middlesex Hospital found that the residue left after the removal of the residual lipid appeared from its nitrogen content to be entirely protein.

Work by Amies on the nature of the tumour-producing agent in fowl sarcomata appears to lend support to the conception of the dual nature of the infective complex held by Gye and Purdy, who consider that the production of a tumour depends on the presence of an extrinsic factor, the virus, and an intrinsic factor provided by the tissues of the host.

In the Report for 1936 from the Lister Institute it was stated that the following conclusions had been reached: The tumour-producing agents of the Rous No. 1 sarcoma and the Fujinami sarcoma are particulate in nature and can be deposited (1) from cell-free extracts by means of the

high-speed centrifuge; (2) by repeated centrifugation it is possible to remove most, if not all, of the extraneous material. This degree of purity is shown by the fact that the final suspensions which are actively tumour-producing fail to give a precipitation reaction when mixed with anti-fowl sera; (3) the sera of tumour-bearing fowls contain antibodies which agglutinate these tumour agents in specific fashion. All the experimental evidence so far obtained indicates that these bodies are produced in response to antigenic constituents of the tumour agent itself, and that they are not cytotoxins for the sarcoma cells. This does not, however, exclude the possibility that immune bodies of the latter type may also be present.

Amies now reports that he rendered rabbits hyper-immune to normal fowl protein by giving them a series of inoculations of freshly drawn citrated whole blood of normal fowls. The sera of these rabbits were found to contain anti-fowl hæmolysins and precipitins to a high titre. These anti-fowl sera were mixed with suspensions of the Rous No. 1 tumour agent freshly prepared by high-speed centrifugation. A mixture of the tumour agent, guinea-pig complement, and the serum after incubation, was inoculated intramuscularly into young chickens. Controls of the tumour agent and normal rabbit serum were also injected. The complement was found to be unnecessary. Nineteen samples of the anti-fowl sera were found to neutralize suspensions of the tumour agent. Growths occurred in the control chickens.

Further experiments showed that the neutralizing effect was not produced by immobilizing the tumour agent within a protein precipitate.

The specific nature of the neutralization has been shown by the fact that it is possible to separate the components of a neutral tumour agent. This has been done by centrifugation of this neutral agent at 20,000 revolutions per minute for forty-five minutes. The deposit so obtained was found to be as active as the original tumour agent. The supernatant fluid, moreover, was as potent in neutralizing activity as the original serum. This experiment discounts the explanation that the antibody is attached to particles of tissue débris which may be present as a contamination of the tumour agent suspension, because in such a case the absorption would not be reversible.

Amies writes that the experiments with anti-fowl serum might be taken as evidence of the presence of an intrinsic factor; at present, however, it seems preferable to summarize these findings by stating that the particulate tumour agents have an antigenic constituent which is the same or at least closely related to one that is normally present in fowl tissues. The phenomenon has no counterpart in any of the recognized virus infections. A potent goat anti-rabbit serum, for example, has no inhibitory effect upon a suspension of vaccinia elementary bodies prepared from lapine. On account of this property alone the avian sarcoma agents must be placed in a class of their own.

Dr. Thomas Lumsden, Director of the London Hospital Cancer Research

Laboratory, in his report recapitulates the progress that has been made in the study of tumour immunity. A fact of fundamental importance is the discovery that if a rat has recovered spontaneously from cancer implanted into it, further inoculations of cancer cells are unable to survive and grow in this rat. If the inoculations are repeated the serum of the rat becomes highly poisonous to cancer cells, though it is quite harmless to the normal body cells of the rat. The production of these anti-cancer bodies in the serum of the rat is a part of the mechanism of cancer immunity. But that it is not the entire mechanism is shown by the following experiment: If a mouse cancer is inoculated into a rat it may grow for a week or ten days and then disappear. But if at the height of its growth after about seven days, a portion of the tumour is removed, the cells composing it can be kept alive for several weeks by feeding them with the serum of the rat in which it had been growing, yet the part of the tumour left in the body of the rat has been killed out and disappears in three or four days. Therefore some other factor must have been operating in the rat's body which is not present in the serum.

If fragments of rat cancer are injected into sheep they do not form a tumour, but the serum of the sheep is found to contain anti-cancer bodies and to be more toxic to rat cells than it was before. Such a serum can be used for the treatment of cancer, but experiments show that this is only effective up to a certain point, and it is probable that the antibodies in the serum are only one factor in the curative process.

The treatment of implanted tumours in rats with antiserum gives much better results than in the case of naturally occurring tumours.

If a rat has two tumours implanted in parts where it is possible to maintain a high concentration of serum and if one tumour is treated with anti-cancer serum, not only does the treated tumour disappear, but in a week or so the untreated one regresses and finally disappears. This shows that during treatment the animal is vaccinated, and this immunization is general and permanent, as inoculation of cancer tissue into any part of the rat's body, even many months after cure, fails to produce any cancerous growth.

Dr. Lumsden considers that we have discovered a part, but not the whole, of the mechanism by which animals combat and not infrequently win the battle against cancer implanted into them. Though we have discovered a serum capable of sometimes curing cancer in animals and rendering them immune, the proportion of cures in spontaneous cancer is too low and uncertain. Sometimes an adjuvant factor comes to our aid and sometimes not. He thinks a wide and intensive search must be made for this adjuvant factor. His experiments have shown that anti-cancer bodies are not isohæmolysins.

The dissemination of a filtrable agent from Rous sarcoma throughout the normal tissues of fowls has been studied at Sheffield in the field laboratory.

Work previously carried out by Sir Edward Mellanby has shown that

the cancerous agent from Rous sarcoma can survive and possibly multiply in normal organs without producing a cancerous growth during the experimental period, and that the fowl has limited powers of neutralizing the cancer-producing virus by the production of antibodies.

It has now been found that the cell-free filtrates of normal organs of fowls bearing a Rous sarcoma twenty-seven days old would produce growths when injected into cancer-free fowls. It was clear that after carrying a virus tumour for twenty-seven days but little neutralization of the virus had resulted.

A further experiment bearing on this point was made by injecting cancer virus directly into the blood with the object of seeing whether the cancer virus remained in the normal organs, and if so, how long. If cell-free extracts from an organ, say the spleen, are made two hours after such an injection it is found that these extracts produce growths in normal birds. Three days after an injection the growths appeared late and were slow in growing. It seemed as if the injected virus had remained in the fowls over this period, but probably had not multiplied.

At Sheffield other experiments have been made on the transmission of the Rous virus to chemically induced tumours. If a fowl carries two types of cancer, one in the breast after injection of dibenzanthracene, and the other in the leg by injection of Rous filtrable virus, it has been found that a cell implantation from the dibenzanthracene tumour produces a dibenzanthracene tumour, while a cell-free filtrate inoculation from the same tumour produces a Rous sarcoma. Normally growths of dibenzanthracene tumours are only produced by inoculation of the cells themselves. The metabolic activities of the dibenzanthracene tumour and the Rous sarcoma are very similar, both have high glycolytic but low oxidative powers. The general structure of the two sarcomas generally allows of their easy differentiation.

The interaction of tumours of the filtrable and non-filtrable type in the same animal or bird is of great interest, and since the work was reported Peyton Rous, in his experiments on rabbits, has shown that a cancerous filtrable agent stimulates to great activity growths induced by tar.

The study of growth has continued throughout the year and has been greatly helped by the discovery of a method whereby the growth-promoting activity of adult tissue extracts can be measured and compared by means of cinematograph films of cultures of living cells *in vitro*.

Using this method E. N. Willmer at the Physiological Laboratory, Cambridge, has found that the most active extracts are those from the thymus and the testis. Kidney and liver produced a slight positive effect. Muscle showed no growth-promoting activity, nor, surprisingly, did the spleen.

The effect of injecting oestrogenic hormone into animals has been studied and it has been found that this hormone may act as an intrinsic carcino-

genic agent. Female mice naturally resistant to the development of spontaneous tumours when injected with oestrogenic hormone, or this combined with prolactin, may develop mammary cancer.

Various reports have shown the complexity of the biological effects produced by radiation. The gamma-rays acting on bacteria have been found in certain circumstances to produce abnormal forms; radiation, in addition to its lethal action has the power of inhibiting division without hindering the increase in volume of the individual organisms. The lethal action of X- and Beta-rays on *B. coli*, and on the spores of *B. mesentericus* has been tested. The two organisms were equally sensitive to radiation, but differed widely in their sensitivity to Beta-radiation.

The relation of diet to internal cancer is being investigated and examination of the liver for carcinogenic agents is being made by Dr. Hieger at the Cancer Research, Royal Free Hospital. The earlier work with carcinogenic agents was based on the production of tumours in the skin and in the connective tissue of the animal body. Lately it has been found possible to produce tumours of the internal organs, such as the liver, by feeding rats with o-amido-azo-toluol and facts have been brought into prominence which appear to connect diet with cancer in the human subject. Primary cancer of the liver is rare in Europeans, but is very common in the Bantu races of South Africa, in the Far East, in Java, and in parts of India. Genetic factors may be of importance in the selection of the liver as the site of disease, but in view of the action of o-amido-azo-toluol, the diets of these people are now being considered for possible factors. It is possible that the prevalence of cancer is connected with the highly spiced food consumed in Java. Experiments on this problem are now in progress by Dr. Hieger in collaboration with Dr. des Ligneris at the South African Institute of Medical Research in Johannesburg, who is studying cancer of the liver in Bantus.



## Clinical and other Notes.

### ACUTE INTESTINAL OBSTRUCTION DUE TO MECKEL'S DIVERTICULUM.

BY CAPTAIN D. T. SWIFT, M.B.,  
*Royal Army Medical Corps.*

AN acute intestinal obstruction due to Meckel's diverticulum is a rare and very fatal lesion, because of mistakes in diagnosis and delay in operating. The following case is, I think, worthy of record.

On August 10, 1936, Major F. Holmes, O.B.E., R.A.M.C., Medical Specialist, Baluchistan District, asked me to see Private D., who had been admitted to hospital at 20.00 hours on August 10, with the following history:—

At 16.00 hours while on guard duty he had been seized with acute pain below the umbilicus radiating to the right iliac fossa. Pain was colicky in character, but did not disappear entirely between spasms. He had vomited once before admission, but this had had no influence on the pain, and his bowels had not acted.

*Previous History.*—Nothing of note.

*Examination.*—Temperature, 98·4° F.; pulse-rate, 64. He looked well enough, but did not like moving about in bed. The tongue was moist and slightly coated at the sides. The abdomen showed little distension, moving with respiration. There was no definite rigidity, although examination of the right iliac fossa was resisted, and he complained of definite tenderness over McBurney's point and to the right of the umbilicus. The pouch of Douglas was acutely tender on the right side. The hernial orifices, psoas, and obturator tests were all negative.

*Blood Examination.*—No malaria parasites were found. White blood-count: Total, 10,000 per cubic centimetre. Differential, per cent polymorphs; 18 per cent lymphocytes; 2 per cent mononuclears.

After admission he vomited twice, a few ounces of bile-coloured fluid each time.

I agreed with the diagnosis of acute appendicular colic, so the operation was commenced at 00.30 hours, August 11, with a right gridiron incision.

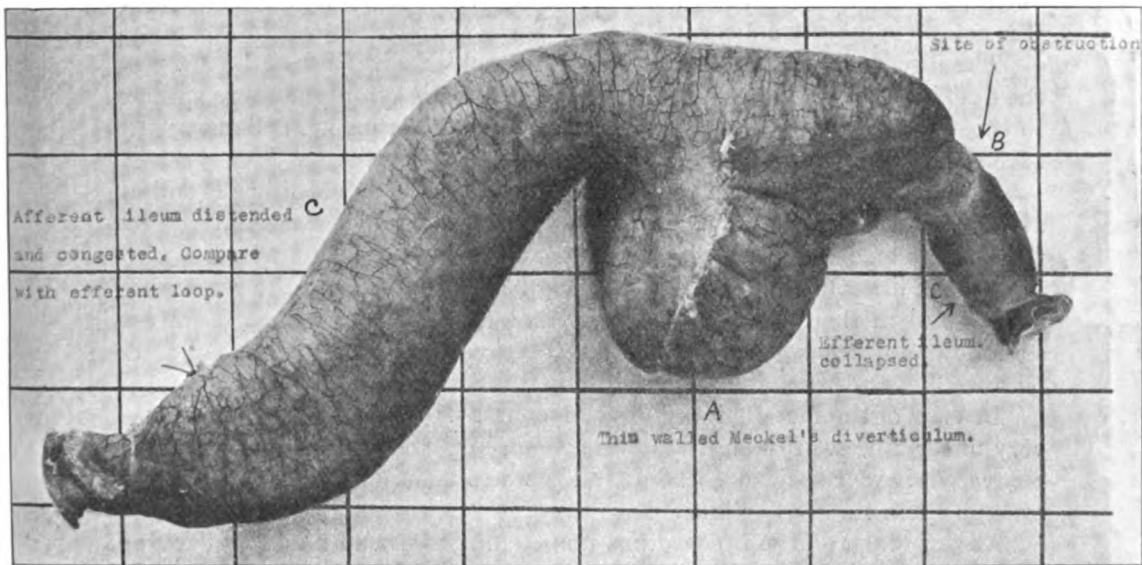
The peritoneal cavity contained an excess of blood-stained serous fluid; the cæcum was empty and appendix normal. What appeared to be distended small bowel could be felt, showing that the condition was really one of acute intestinal obstruction. The incision was closed without wasting time in performing an unnecessary appendicectomy, and the abdomen reopened by a right paramedian incision.

A distended loop of small bowel presented, and fortunately quickly led

to the site of the obstruction, namely a Meckel's diverticulum (A) about the size of a man's fist impacted in the pelvis. The efferent loop of ileum (C) was twisted behind the obstruction and showed a well-marked constriction (B) (this is well shown on the photograph). As the diverticulum seemed so thin and petechiæ were present at the neck, about 12 in. of ileum including the diverticulum were resected and an end-to-end anastomosis performed, the abdomen being closed without drainage.

Bronchopneumonia developed, but the temperature was normal by the fifth day and convalescence thereafter uneventful. At no time was he distended; in fact he was passing flatus twelve hours after the operation.

Although the specimen had been opened and preserved in formalin



before being photographed (and therefore shrunk to half the original size), the photograph shows very well the condition found at operation.

On opening the diverticulum it was found to contain pieces of unskinned green apple which the patient informed us he had eaten on the morning of August 10. He writes to say (February 26, 1937) that he is now quite fit and doing duty,

The case illustrates the following points: (1) The similarity in symptoms from lesions of the vermiform appendix and those of Meckel's diverticulum; (2) the need for re-assessment of symptoms and signs if the original diagnosis is wrong; (3) the good result from early operation in acute intestinal obstruction.

I am indebted to Colonel D. F. MacKenzie, D.S.O., for permission to send this case for publication, and to my colleagues, Major F. Holmes, O.B.E., R.A.M.C., and Captain J. J. Sullivan, R.A.M.C., for their assistance with the operation.



## AN OUTBREAK OF FOOD POISONING.

BY CAPTAIN P. B. HANBURY,  
*Royal Army Medical Corps.*

A LOCALIZED epidemic of food poisoning involving both the civil and military community, and numbering approximately twenty-four people, occurred in Karachi on June 27, 1937.

Of these twenty-four cases, fourteen occurred in the officers' mess of the Royal West Kent Regiment. As these cases were the first to be discovered, and were the only ones, with the exception of one R.A.F. officer, to be admitted to the British Military Hospital, it is with these that this article is mainly concerned.

The discovery of a sick officer at the Karachi Yacht Club at 1 p.m. was the first indication I received of the outbreak. His symptoms were similar to those of all the other cases that were admitted later, i.e. collapse, with severe diarrhoea and vomiting.

Arrangements were made to transfer him to the British Military Hospital at once, and he was admitted at 2 p.m. At the hospital I was informed by the orderly medical officer that there were ten more officers who had also been taken ill. Of these 10, 2 had already been admitted and the remaining 8 were still in their quarters in the Mess, but when I arrived at the Mess some few minutes later I found that there were 11 patients instead of 8, because 3 of the Mess staff had been taken ill.

In view of the fact that the clinical course of each individual case was very uncertain, even though a few of them appeared to have more or less recovered, it was decided to admit all cases to hospital without delay, and to keep them there overnight.

At this stage of the proceedings no attempt had been made to discover what the possible cause of all these cases might be. Both the number of cases and their strict localization made it almost certain that food poisoning of some sort was the cause—but what the poisoned material was, and whether it had been eaten in or out of the Mess, and, if in the Mess, whether for breakfast that morning or for some meals the previous day, was not known. The officers themselves, when questioned, stated that they thought it was some bad ham they had had for breakfast that morning. Unfortunately there was no ham left to inspect as it had been all eaten, and in any case they were all prejudiced by the fact that it was tinned ham.

The key to the whole situation, however, lay in a chance remark made by one patient. He stated that an officer had arrived by ship that morning and had been the first case to be admitted to hospital. He had had breakfast in the Mess, his first meal on land, and had eaten the ham. It was then decided that something eaten at breakfast was the cause, and that the ham was the strongest probability.

The Mess was then visited by the medical officer in charge of the Regiment, who took samples of milk, butter, water and ice to the Brigade Laboratory for analysis. The local stores from which the ham had been purchased was informed of the outbreak and forbidden to sell any more of that particular ham. By that time, however, as later events proved, small quantities had been sold to various people (ten in number), all of whom had been taken ill some time during the afternoon or evening of the previous day.

The cases themselves were typical of food poisoning, and I do not propose to go into them in detail. The incubation period was short and varied from two to four hours. The main symptoms were: violent vomiting, severe diarrhoea, weakness and collapse, and in one or two of the more severe cases symptoms of dehydration, i.e. chilliness and muscular cramps. All cases complained of abdominal pain.

Two cases had fever of 100° F.; the temperature of the others was normal or subnormal. The vomited material in most cases was watery fluid with or without a little food, but two cases showed definite blood that could be seen with the naked eye. The stools were very fluid in all cases; three contained mucus and one a little blood.

The treatment adopted was of the simplest. All cases except three were put to bed and given castor oil  $\frac{1}{2}$  ounce and tinc. opii. mxx, with as much bland fluid as they wanted to drink. The remaining three cases were given morphia  $\frac{1}{4}$  grain and treated as for shock.

Apart from this no further treatment was necessary, and by 10 p.m. the same night most of the patients were comfortable.

They all made an uneventful recovery.

Finally, a few words concerning the bacteriological findings:—

After the Brigade Laboratory had investigated this side of the question, the Dutch firm who supplied the ham sent out their own bacteriologist by air, and I do not think I can do better than quote from his official report on the matter:—

“The real cause of these cases of food poisoning could not be stated, as no food sample of the incriminating ham was available for analysis. We cannot produce evidence to say that the ham was not the cause of poisoning. The nature of the illness certainly points to a typical intoxication such as has been noticed, sometimes to be caused by coli bacilli. I have examined eleven tins out of the consignment, i.e. the ones Dr. — analysed before; two tins from Dr. —’s office, one of which was blown and perforated, and seven other tins that appeared to be in good condition. Coli bacilli were found in two tins, i.e. the one Dr. — examined, and in which he found coli bacilli, and the blown and perforated tin obtained from Dr. —’s office.

“We are now of the opinion that the poisoned ham must have got infected from outside through a perforation caused by denting the tin.

“We had the opportunity of examining several hundred tinned hams

during the last few years and have never found *Bacilli coli*. As a result of long experience we feel justified in saying that if, in any tinned ham, coli bacilli or any other non-sporogenic bacteria are found to be present, they must have got inside through some hole caused by denting or a fault in the seam of the tin.

"As regards the poisonous ham, it was just unfortunate and unusual that no distinct signs of decomposition or swelling could be seen, and that the ham was apparently all right. It must be considered a great exception that a coliform or similar organism able to produce toxins, but not betraying itself by the formation of other products (gas, smell), has got into the tin.

"As a rule perforated tins get blown or the contents become decomposed, and are consequently unfit for consumption. It is possible, however, for a bacteria to develop in the jelly of the ham without producing gas or other products of decomposition in detectable quantities, on account of the high salt concentration."

Although the actual bacteriological findings in this case are interesting, I think that the most important point that emerges is the fact that in a dented tin, however mild that dent may be, perforation must always be suspected, and the greatest care should be taken in examination before deciding whether tins showing dents, however small, should be passed as fit for human consumption.

I am indebted to Lieutenant Colonel W. L. Webster, R.A.M.C., Officer Commanding, British Military Hospital, Karachi, for permission to forward this article for publication, and to the Director, the Dutch Firm, Rotterdam, for permission to include their official report on the outbreak in this article.

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## Travel.

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### FRENCH INDO-CHINA AND SIAM.

BY LIEUTENANT-COLONEL J. R. HAYMAN,  
*Royal Army Medical Corps.*

THIS is a brief account of a tour through the southern part of French Indo-China and Siam. It also includes a visit to the famous Temple of Angkor Vat in Cambodia.

The journey commenced from Singapore in May, 1932. There is a direct connection between Singapore and Saigon, the capital of French Indo-China, by the Messageries Maritime Steamship Company, and the voyage takes two days.

I travelled second class on the s.s. "André Lebon," and found the cabin accommodation and food quite good, but the deck space was rather restricted.

Among the second-class passengers there were six French priests and six French nuns, also one American missionary and his wife, all of whom were going to Indo-China to carry out missionary work presumably.

There appeared to be a general feeling of depression among the passengers. This may have been partly due to the fact that they had just witnessed the burning of the sister-ship, the "Georges Phillipar," off the coast of Aden.

Apropos of this catastrophe, the French newspapers in Saigon had a few remarks to make in connexion with an interview given by an English traveller on the ill-fated ship.

One editor naively observed that in future foreigners should not be allowed the privilege of travelling on French liners!!

On the morning of the second day the s.s. "André Lebon" reached the southern coast of Indo-China. The boat then proceeded up the Saigon River. This is a narrow, tortuous channel, rather more like a creek than a river, and it took four hours to reach Saigon itself. The land on either side is flat and marshy.

At the Port of Saigon the river is so narrow that there is barely space enough to turn the boat round.

Saigon has been variously described as the "Paris of the East," the "Pearl of the East," etc. Broadly speaking, it is composed of three towns: that is Saigon proper, the European settlement; Cholon, the Chinese town; and Gia Din, the Annamese town. The total population is approximately a quarter of a million inhabitants.

The European settlement is laid out with methodical precision in the American style, and has its boulevards, avenues and streets running at right-angles.

A tourist should have little difficulty in finding his way about the place after he has been ashore for a couple of hours. Apart from actual walking, the favourite means of transport is the rickshaw, which is known locally as the *pousse-pousse*.

The accommodation in the local hotels is good, but rather expensive. For example, a provincial hotel advertises its terms at the equivalent of 25s. per day, while an extra charge is made for hot baths at 4s. 2d. per person, "including all accessories!"

The local shops in Saigon sell practically nothing else but French goods, and it would seem that foreign competition is not welcomed in this colony.

The French reputation in the culinary art is scarcely enhanced in Indo-China, unless it be that the local inhabitants have a penchant for veal, tripe and brains. Personally, I usually left the dinner table feeling hungry.

Saigon has little to show as regards structures of any historical interest. The city is of modern development, though the site had previously been occupied as a village or fort for some centuries. Most of the larger

buildings would appear to be utilized by Government Departments, of which there are an unusual number. The frontages of these buildings were gaily beflagged with the national colours.

The history of the French occupation dates back to 1788, when a local French bishop asked for assistance from a French Naval force to help to quell some local disturbances. Since that date, the sphere of French influence has been gradually extended until, at the present time, the area of the Colony is considerably greater than that of France itself.

In 1907 the Government "acquired" the provinces of Battambang, Sisophon and Siemréap from Siam, but that, of course, was before the League of Nations came into existence. The Colony includes a number of races, the principal ones being Chinese, Annamese, Cambodians, Chams, and the Moi or aborigines.

Little need be said here in regard to the military aspect in the Colony, except to infer that in view of its geographical and political situation, and the number of troops maintained there, it might have been expected that more interest would have been taken in this subject.

Saigon may have been described as the Paris or Pearl of the East, but really there appeared to be little to attract visitors to the city or induce them to prolong their stay there. Consequently, I decided to continue my journey on to Angkor with as little delay as possible.

A railway is in the process of being constructed between Battambang, adjoining the Siamese Frontier, and Saigon, but only sections of it have been completed to date.

The usual way to get to Angkor is to travel by road, and this can be done either by autobus or taxi. Alternative routes are by coastal boats proceeding to the Great Lake near Siemréap, near Angkor, or by hydro-plane to Angkor itself. The distance by road is 350 miles, and I had already arranged to go by bus, a local form of charabanc.

An early start was made at 5 a.m. on the first day, and by 11.30 a.m. the bus reached Pnom Penh, the capital of Cambodia. The distance was 150 miles, and this completed the first day's journey. The country in this part of Indo-China is flat and there is a considerable amount of fresh vegetation. The land, however, is not cultivated to the extent that might have been expected, and the district seemed to be sparsely populated.

Pnom Penh is a large town with a population of 75,000 inhabitants, mostly Cambodians, Chams, Chinese, Moi and a relatively few Europeans. The European Settlement is attractively laid out, but the rest of the city has the usual appearance of any native town in the East.

The King of Cambodia has his palace adjoining the native city. Visitors are allowed to visit certain parts of the Palace building by special permit. Among the objects of interest to be seen there are three large statues of Buddha. One of them is carved from a solid block of green jade; one is carved from alabaster and the third one is made of gold and studded with diamonds. The gold statue, which is more or less life-size.

is said to have cost over £60,000. In the Palace courtyard there is an elephant kraal, and it is here that the sacred white elephant is kept. It is a comparatively small specimen of its breed, though it is said to be over 30 years old. Its actual colour is dark grey, and it has greenish-grey eyes. This female elephant is supposed to be one of the reincarnations of Buddha.

The King's Palace is not an imposing building. There is little else in Pnom Penh that is worth describing.



Pnom Penh.

The history of the Province is rather interesting. The local Cambodian is considered to be the direct descendant of the Khmers. This was the race that ruled the Empire of Angkor for six centuries, between A.D. 800 and A.D. 1400. Some idea of the extent of this Empire may be gauged when it is stated that the Government at one time could raise an army of 15,000,000 men from its own people and the vassal States. Eventually the Khmers were defeated by the Siamese during the fifteen century. Their capital at Angkor Thom was pillaged and destroyed. The capital was then abandoned and reverted to jungle.

A new capital was formed at Pnom Penh, which lies 200 miles to the south-east, and here it has remained ever since, except for brief periods.

The Cambodian of the present day gives little indication of the prowess of his forefathers.

The following morning the bus started at 6 a.m. *en route* for Angkor, a distance of 200 miles.

A mid-day halt was made at the village of Kompong Thom, when the passengers had an opportunity of getting lunch at a reasonably good local hotel.

According to the hotel circular the district is the centre for big game hunting. In the surrounding neighbourhood there exist elephant, tiger, bison, rhinoceros, leopard, panther, wild buck, etc. Judging from the terrain and the type of local vegetation, the district is well adapted as a big game preserve.

Arrangements can be made with the manager of the Grand Hotel, Kompong Thom, to organize big game shooting parties, with guides, bearers and provisions, &c.

Continuing the journey from Kompong Thom the road passes alongside the Great Lake near Siemréap. This lake varies in size from 1,200 to 5,600 square miles, according to the period of the year.

The intermediate river is navigable to coastal steamers as far as this lake, and tourists can therefore come by this route instead of by road.

Siemréap itself is a picturesque little town built on either side of a large tributary of the lake. There are plantations of areca nut and orange groves, which add to its attractions.

Irrigation is carried out by water raised from the local stream by a series of water wheels, which are very primitive and ingenious, and apparently very efficient.

There are two hotels at Siemréap, both of which are well recommended. The distance to Angkor is only four miles, so that many visitors prefer to stay here, rather than at the Hotel des Ruins, which is within a short distance of Angkor Vat.

The bus reached the village of Angkor soon after 4 p.m.

It was a tiring journey, coming 200 miles on a shaky bus over some rather indifferent roads, so one felt quite glad to reach the hotel and have a little light refreshment, and get settled in.

However, it seemed a pity to waste the remaining short space of daylight, so I decided to make a preliminary survey of the Temple buildings of Angkor Vat and then read up the details of the place from a guide book later in the evening.

Any reader who has seen the Taj Mahal at Agra can visualize the ground plan of Angkor Vat, except that this is built on a much larger scale and is surrounded by a very wide moat. Within the moat there is a high stone wall which forms the outer rampart of the temple enclosure. Within this again are the temple gardens, the great temple itself, and some smaller buildings.

There is a short walk from the hotel to a wide stone bridge, which crosses the moat. This leads to the Royal Portico or main entrance on the western frontage. On the inner side of the Royal Portico there is a wide causeway extending about 500 yards to the Temple itself. On either side



Angkor Wat. Aeroplane view facing north-west. The palm trees give some idea of the size of the Temple.

of this causeway there are extensive gardens and the remains of two small buildings. The whole plan is perfectly symmetrical. It was a quiet peaceful evening and not a soul was to be seen. Altogether, there was an uncanny air of solitude about the place. The outer corridors of the main



building were in semi-twilight. The inner corridors and galleries were darker still. These corridors seemed to be alive with bats which uttered shrill squeaks whenever they were disturbed. Added to this, the odour from these creatures must be experienced to be believed.

The whole effect was definitely sepulchral. It was too late to do any further investigation, so I decided to return to the hotel and read up the details of the history and structure of the building from the local guide book. As I was crossing the bridge I turned round and gazed in wonder that such a magnificent building should have been designed and constructed.

The temple was beautifully silhouetted against the sky. A small oil lamp glowed from one of the upper windows giving it a further mystic effect.

My thoughts, however, were disturbed by a peculiar grunting sound from behind. On turning round I saw an apparition which looked like a black human scarecrow. A necklace of ornaments like electric bulbs were fastened round its neck. And as if from nowhere there appeared four or five other similar apparitions. One's first impression was that the devils incarnate or the departed spirits of the Khmers had come back to life.

However, these human apparitions soon made it clear by their cringing menacing manner that what they wanted was backsheesh. For the moment it was rather difficult to know how to deal with the situation, but an assumed appearance of anger fortunately had the effect of getting rid of them. Evidently this form of mimicry was a happy inspiration on the part of some local villagers to extract some largesse from unsuspecting tourists.

The following day was spent in making a more detailed examination of the temple buildings and surroundings.

The total area is laid out in the form of a square. This is encircled by a moat having a total length of approximately  $3\frac{1}{4}$  miles. The width of this moat is about 200 yards, and depth about 10 feet. Incidentally a small sector of this moat is now used by hydroplanes going to and from Saigon.

The Royal Portico or Western Entrance is a fine structure with a breadth of 230 yards. The causeway is paved with stone slabs and runs direct from the Royal Portico to the central terrace on which the temple is built. The two buildings on either side are supposed to have been used as libraries.

The area on which the temple itself is built is said to cover over 40,000 square yards. It is flanked by a row of galleries built in the form of a square. The length of these galleries is 3,200 yards. The outer sides of the galleries are open and look on to the adjoining gardens, while the inner sides are closed by stone slabs. These are covered over with friezes or bas-reliefs, depicting historical, mythological, and religious episodes. The carvings extend literally for hundreds of yards.

This outer circuit of galleries encircles an area within which rises the main body of the temple. Within this area also there are more galleries

and the remains of four stone water tanks used for ablution purposes. The temple rises in three tiers. A flight of steps leads up to the second tier where there are still more galleries, also sanctuaries and ornamental carvings. Within this again there is a very steep flight of steps leading up to the central tower or Prasat. This was the holy of holies and contained the statue of Vishnu, to whom the temple was dedicated. History relates that the last king of the Khmers ordered his followers to wall him up alive inside this tower so that he could die alone with his gods rather than fall into the hands of his enemies the Siamese. On the outer walls of this tower there are numerous carvings depicting girl dancers in different poses. The highest point of the building rises 215 feet above the ground level and from here an extensive view of the surrounding country can be obtained.

The central tower is flanked by four smaller towers sited at the corners of the second tier. This gives the building the effect of greater symmetry.

Another interesting feature in the architecture is that only stone slabs were used in the construction. In the case of the roofs these slabs were dovetailed and fitted with such precision that even to this day there is little evidence of leakage of rain water into the galleries.

It might be of interest here to give a brief account of the history of the Khmer race who built this temple. So far as is known, the surrounding district formed a vassal State of the Kingdom of Founan up to the fourth century. This empire extended approximately from the Gulf of Siam to within measurable distance of the China Sea. The religion of the people was then presumed to have been Buddhism. At this period there was an influx of traders from India and China. These people intermingled with the local inhabitants and formed what was to become the Khmer race. The religion then changed from Buddhism to Brahmanism.

During the ninth century the country came under the rule of the Kingdom of Java and Sumatra.

About the year A.D. 900 the reigning monarch made his capital at Angkor Thom, which lies a little over a mile from Angkor Vat. During the next six centuries the Khmer kingdom reached such a state of wealth and magnificence that it was famous throughout the East and the envy of the neighbouring kingdoms. The Angkor Vat is supposed to have been built during the twelfth century.

Eventually, during the fifteenth century, the Khmer kingdom was overthrown by the Siamese, as previously mentioned. The capital at Angkor Thom was then pillaged and to a large extent destroyed. The capital and the Temple were then abandoned and became overgrown by surrounding jungle. The new capital was formed at Pnom Penh, which lies 200 miles to the south.

It was not until 1850 that the existence of these ruins became known to Europeans. At that time the district was under the rule of the Siamese Government.

Little was done to open up the country again until the French Govern-

ment annexed the adjoining provinces in 1907. Since then roads have been constructed and the ruins, to a large extent, cleared of jungle. And here it might be mentioned that, while the old city of Angkor Thom and the Temple are the chief sources of interest, there still remain the ruins of some six hundred other structures in the district.

The second day was spent in exploring the old city of Angkor Thom. Like the Vat, it was built in the form of a square and surrounded by a moat. Each side of the square measured approximately two miles, so that the moat was approximately eight miles round. However, it was only half the width of the other moat, that is to say about 100 yards wide. Within the moat, the city was surrounded by a high stone-walled rampart. The city itself was divided into four squares by two main avenues, which ran north and south, and east and west. The avenues terminated at the four entrance gates. The moat was bridged at these points. The gateway for the southern boundary is a massive structure rising twenty feet. Passing through this entrance and proceeding along the main avenue, the first object to be noticed is Bayon. This was a temple that was second in importance to the Vat. Like all the other buildings in the Imperial City, this place was partly pillaged and destroyed, though it escaped with less damage than the rest. With regard to its structure, it had an outer projecting wall which enclosed an area in which the main temple was built.

The temple rose in three tiers. On the ground floor there is a maze of galleries and corridors in which it is easy to lose one's position. The walls are covered with carvings in bas-reliefs. These depict battle scenes, mythological subjects and contemporary events, such as that of a priest being chased up a tree by a tiger. The second floor was somewhat similar to the first. The third floor was the sanctuary and contained the phallic emblem of Siva. The whole building was as intricate as a rabbit warren.

The next ruin to be seen was the Temple of Bayon. However, little of the original structure remains except the ground floor and a little of the second floor.

Of the Royal Palace there is even less to be seen, though the ground plan and some of the walls are still preserved.

Apart from these buildings, there are the remains of various other temples, shrines and sanctuaries in the city, but they do not call for any particular description. In the evening I walked back to the hotel. The road is fringed on either side by jungle. Lying in the scrub there was a curious brand of local tree frog or beetle. The noise from this creature was like the blast of a whistle from a steam engine. It would begin quite suddenly on the approach of a pedestrian, and was a little disconcerting considering that there were tiger and other wild animals in the district.

Among the other structures of local interest were two large artificial lakes. One of them, the "Sra Srang" or Royal Bath, is supposed to have been constructed for the exclusive use of the Royal Family and Church Dignitaries. The second one, the "West Travail," is supposed to have been used as a reservoir and fish preserve for the Royal City.

I might mention that most of this information is obtained from a guide book called the "Tourists' Guide," which is published in Saigon, and is printed in English.

There are numerous other books dealing with the history of Indo-China,



A modern Buddhist Temple, Indo-China.

and the ruins of Angkor, which have been written by various French authorities.

The next stage of the tour was to reach the Siamese Frontier Station at Aranya Pradsa, and from there to go by rail to Bangkok. There is a short cut by road from Angkor to Aranya Pradsa, the distance being only 103 miles, but this route is only possible during the dry season. Unfortunately I had to go by the circuitous route via Pnom Penh, and this

meant another 430 miles by autocar. So, another night was spent at Pnom Penh.

The next day the autobus reached Battambang, the capital of the province of that name. Battambang is more like a large native village than the capital of a province. It is not a prepossessing place, but it gave one an opportunity of observing native life *au naturel*.

The dak bungalow, too, was a drab-looking affair, though it improved on acquaintance in view of the very obliging personality of the local native manager.

An unusual feature of this dak-bungalow was a comparatively pretty native girl who was much in evidence along the corridors. She appeared to assume that visitors would welcome her services.

The following morning another early start had to be made at 5 a.m. in order to reach Aranya Pradsa in time to pass the Customs Post and to catch the train for Bangkok. Fortunately the formalities of the Customs' officers at this place were not exacting, and in any case it was not clear what one was likely to remove from Indo-China to one's advantage.

The train started to time at 9.30 a.m., and made slow progress towards Bangkok, which it reached soon after 5 p.m. The carriages were clean and comfortable, while the guard was a cheery fellow who spoke fairly good English.

Unfortunately there is no restaurant car attached to this train, and there appeared to be no means of getting food or drink on the way. It was a long wait between a small breakfast at 4.30 a.m. and some food at the Bangkok Hotel at 5.30 p.m. The country along this eastern portion of Siam is, generally speaking, as flat as a billiard table, and it is extensively cultivated for rice.

There is a small stretch of jungle country adjoining the French frontier but this may have a strategical purpose. An interesting feature of Siam is the absence of roads except in the immediate vicinity of towns. Consequently most of the transport has to be done by railway or waterways. The railway system is a Government service and it is under very efficient management. There is a direct line which runs from the French frontier in the east, through Bangkok to the British or Malaya frontier in the south, where it connects up with the Malayan Government Railway service.

Some of us might have pictured Bangkok as a beautiful town in the east, filled with the spirit of romance. However a closer acquaintance of the place soon dispelled that illusion.

It so happened that this was the season for the durian fruit, and there must have been a wonderful crop, for the unsavoury stench of this so-called fruit was only surpassed by the emanations from the beds of the drying canals of the city. Added to which there was a plague of mosquitoes of a particularly bloodthirsty species. The streets certainly had an Eastern aspect, but the shops were more or less entirely in the hands of Chinese

with the exception of a few European establishments. It is said that there are only two grades of society among the Siamese, the ruling or land-owning class and the peasants. The role of middle class has apparently been usurped by John Chinaman.

Bangkok as a town has a comparatively short history. It was founded about one hundred and fifty years ago. The old capital was at Ayuthia which lies about forty miles to the north and which was more or less abandoned from that time. Consequently Bangkok has very few places of any historical interest. There are a number of picturesque vats or Buddhist temples, but I was unable to see the interiors of any of them, as



River scene with a Buddhist Temple on opposite bank, Bangkok.

the caretakers or priests appeared to be conspicuous by their absence. Or it may be that they did not welcome visitors.

Apart from the temples there were a number of royal palaces—more, in fact, than one would have thought essential, but here again the tourist was not encouraged to visit. I searched a local guide book to discover something of local interest, but most of its pages were devoted to advertisements and local English-Siamese conversational phrases. These might have helped to pass the time for an enthusiast in linguistic attainments.

However, there was just one item that attracted my attention, and that was a snake farm, “where the visitor sees specimens of every variety of snake to be found in Siam.” Judging from the paucity of specimens to be seen, there must have been a severe epidemic among the snake tribe

of the country, or else Siam must be singularly fortunate in having so few varieties. However, there was one specimen that drew one's attention, and that was a banded krait which must have measured from 12 to 15 feet long.

Bangkok is stated to have a population of 700,000. It is intersected by numerous canals, and it might literally be said that a large number of its inhabitants exist as a "floating population" on boats in these waterways.

A wide river, which is navigable to coastal boats, connects the city to the seaboard. Anchored amid stream were some Government sloops or light gunboats, but according to local gossip their effectiveness lay rather in their appearance.

The City appeared to be in a quiet, peaceful, and orderly frame of mood. Little did one realize that within a fortnight there would be a revolution in which the king would be given the option of either abdicating or granting various reforms.

The railway journey from Bangkok to Penang takes thirty-one hours by express train, and there are only two such trains during the week. At the end of the first six hours the train reaches Hua Hin.

This is a pretty little seaside resort on the East Coast and is equally popular with Europeans and Siamese. The king also has a palace here. There is some excellent bathing to be had from the beach, and in addition there is quite a good 18-hole golf course adjoining.

The Government railway system has built a modern hotel, which at that time was being very efficiently managed by an English lady.

Coming from Indo-China, it was a pleasure to dine there, and the hotel was really very comfortable. The rest of Hua Hin was rather of the nature of a bungalow village.

The remainder of the journey down to Penang needs little description. The scenery, however, is much more varied. Ranges of hills alternated with patches of jungle and rubber estates.

Eventually the train reached the Malay frontier at Padong Basar. Here it was necessary for the passengers to transfer to the Malay Government Railway system. Unfortunately the latter is neither as clean nor as comfortable as the Siamese system.

The journey continues on as far as Prai, the station which lies opposite the island of Penang. A ferry system is here available to cross over to the island, which is some two miles distant.

Penang used to be the British centre of commerce for the trade with Malaya during the days of the East India Company. It is a very picturesque little island, approximately the size of the Isle of Wight. A high range of wooded hills runs throughout its length.

About a century ago Sir Stamford Raffles, who was then the British representative, realized that the Island of Singapore was better situated both from a commercial and a strategical point of view. Steps were then

taken to develop Singapore, and in a comparatively short time Penang lost a great deal of its trade and its prestige.

The railway journey from Prai station, opposite Penang, to Singapore is scheduled to take twenty-four hours; but to a passenger the journey seems much longer. There is an alternative route by sea, which is to be preferred. On the other hand the main road to Singapore is in a good state of repair and affords very good motoring. The distance is over 500 miles, but there are good rest-houses at convenient intervals throughout the route.

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## Current Literature.

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DUFTON, A. F., & SHEARD, H. **Heat Transmission through Walls—I.**  
*J. Inst. Heating & Ventilating Engineers.* 1937, v. 5, 82-7, 2 figs.

This short paper describes new apparatus recently erected at Garston for measuring heat transmission through walls, together with results of the preliminary tests of two kinds of brick wall. Hitherto such tests have usually been made under somewhat artificial conditions; the new apparatus described is designed to test walls through long periods of exposure to actual weather conditions in winter time, so enabling the experimenters to calculate over-all co-efficients. Six adjacent rooms, each 8 feet by 8 feet by 8 feet form the test chambers. They are kept at a uniform inside temperature of 66° F. by electrical means and the heat energy which is dissipated is metered and recorded. The test walls are built on the north sides of these six chambers.

As provision is made for controlling and metering all the heat through the other sides, floors and the roofs of the chambers, it follows that the heat loss through the test walls will be represented by the difference between the actual heat supplied and the known heat escaping through other parts of the chambers. In this way the flow of heat through the test walls is uninfluenced by any such contrivances as heat metering panels that might interfere with a true record.

As the surface temperatures on both sides of the test walls are also recorded, the surface-to-surface resistance of the walls and the over-all air-to-air conductance are both measurable. The results are given of tests on three 9-inch solid walls of Fletton bricks and one set of three 11-inch hollow walls made of the same materials. The agreement between the different walls forming each set is good in each instance, a proof of the soundness of the method. A sample of wall previously tested at the National Physical Laboratory was also tested at Garston, the results agreeing well. Experiments are now in progress to find out the effects of ventilating a cavity in a double wall.

T. C. ANGUS.

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STENDER, A. Erfahrungen ueber Poliomyelitis aus den Jahren 1931—1936. [**Poliomyelitis in the Breslau District from 1931 to 1936.**] *Klin. Woch.* 1937, v. 16, 1209-12, 1 fig.

Poliomyelitis, like other infectious diseases, seems to be changing some of its characteristics with the course of years. In the epidemics which have occurred in and around Breslau it was noticed that in the 1932 epidemic there were hardly any preliminary small infections, whereas in 1936 there were a number of such. In the three epidemics at Breslau, between 1931 and 1936, the onset was at midsummer and the peak in the early autumn.

Owing to the importance of the early administration of serum, the author observed particularly the early symptoms in fifty-one cases. In addition to headache, rise of temperature, and general irritability, he found the commonest symptoms were stiffness of the neck, pains in the back and limbs, sweating and tonsillitis or pharyngitis. As these symptoms are common to many other infections, it is advisable to do early lumbar puncture and examine the spinal fluid for polymorphic leucocytes. All the cases seen by the author had been admitted to hospital and all of them had some degree of paralysis. Convalescent serum was given intrathecally and at the same time intra-muscularly in doses of 10 to 20 cubic centimetres by each method according to age, but in no case later than three to four weeks after the onset. Marked improvement usually followed in the general condition and in a short time considerable improvement in the paralytic condition. It is maintained that greater benefit can be got by giving serum intrathecally than intramuscularly. [No figures are given of results.]

A. J. COLLIS.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 1.*

J. W. TOMB. **Shock and Allied Conditions.**

In this small pamphlet the author gives an account of some of the recent work on the subject, together with references from various textbooks.

He mentions a number of obsolete theories on shock, but does not refer to the simplest explanation of its causation arrived at by most recent workers on the subject.

He favours the view that it is due to over-stimulation of afferent sympathetic fibres and seems to consider the best treatment a spinal anæsthetic or the injection of ergotoxine.

CHANT, A. G. **The Heating of Schools.** *J. Roy. San. Inst.* 1937, v. 57, 678-85.

This paper is a very short review of past and present heating practice in schools written from the architect's point of view. The author has in mind the difficulties of local authorities in deciding what type of heating to

employ of the many new products of the present day that compete with the old systems.

The pioneer work of Mr. George H. Widdows in designing semi-open-air schools in Derbyshire is considered to be the starting point of modern practice. The original Board Schools were built under ecclesiastical influence—massive and ornate buildings of impressive appearance being erected because the opinion of the day attached no importance to the physiological needs of temperature, ventilation or illumination.

The three fundamental mechanisms for the warming of buildings are defined :—

(1) High temperature radiant heating, as from coal, gas radiant or electric fires.

(2) Low temperature radiant heating, the radiant component of heat from hot water pipes and "radiators," most of the heat from which is actually emitted in the form of convection.

(3) Convection, i.e. the heating of air by contact with hot surfaces, such as the surface of hot water pipes. [Plenum ventilating systems in which air is warmed, may be considered to warm the supply air by forced convection ; a feature of convection heating is that the air in buildings is generally a good deal warmer than the inside surfaces of the walls.]

Dealing in more detail with the systems falling under these three headings the author describes open radiant fires burning coal or gas or heated by electricity as excellent for domestic purposes but unsuitable for schools on account of their localized effects, the risk of accidents, and the difficulty of storing and firing solid fuel. Enclosed slow combustion stoves may still be found in use in the older and smaller schools, but small independent boilers with heating pipes and radiators may well be substituted. Low pressure hot water systems are generally used in this country, the water being warmed in boilers fired by coal, coke, oil or gas. The heat thus imparted to the circulating water may be delivered where required by the usual pipes and radiators, or from panels of large area and low temperature in walls and ceilings or, as introduced by Mr. Widdows, from pipes arranged to warm the floors. It was found that by running pipes in ducts under the floors, floor surface temperatures of 70° F. could be maintained and secured a high standard of comfort, whilst large side openings produced generous ventilation.

[Except in one instance the author has not mentioned thermostatic control and the benefits that it can confer. The great disadvantage of the hot water system so widely used in this country is its inflexibility ; the many tons of iron and water comprising the heating apparatus of large buildings take hours to heat up and to cool down to meet climatic changes. It may safely be said that much of the prejudice against centrally heated buildings that undoubtedly exists in this country is due to the gross overheating that occurs when a period of mild weather suddenly succeeds a cold period. It has also been shown that more than 30 per cent of the fuel cost

to heat a large building was saved after the installation of thermostatic control; the cost of a thermostatic control system would be small in comparison with that of the fuel so saved in the first year in a large building. There are now thermostatic controlled systems available in which the fuel consumption is controlled by two bulbs—one inside and one outside the building exposed to the weather. In this way rapid weather changes are made to control the heat supplied with as little delay as possible.]

T. C. ANGUS.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 2.*

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### Reviews.

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#### REPORT ON THE WORK OF THE LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (INCORPORATING THE ROSS INSTITUTE) FOR THE YEAR 1936-37.

This report contains much that will appeal to those interested in hygiene and tropical medicine.

The activities of the School in regard to research as well as teaching are multifarious and the co-operation maintained by the School with outside scientific bodies, research workers and others, is evidence of the generous manner in which it lays itself out to assist progress in many ways.

Considerable interest is evinced in the work of the School by the Ministry of Health, and during the year under review various investigations on behalf of the Ministry were carried out, such as research in connexion with the methylene blue test for grading milk. The management of the Horton Laboratory which deals with malaria therapy for certain disorders was also in its hands.

Numerous scientific and other institutions held meetings at the School in the course of the year and at a conference and reception in September the Prime Minister launched a national campaign to secure a wider appreciation and a fuller use of the various public health services.

As regards the investigations carried out during the year under review, it appears invidious to select any special work, but the progress made in certain joint researches carried out by the Divisions of Bacteriology and Biochemistry will be of interest to many as it has resulted in the isolation of chemical factors from the organisms of typhoid fever, whooping-cough and of cholera, and from certain strains of hæmolytic streptococci which appear to have effective immunizing powers, and it seems likely that this work will give a new direction to practice in regard to infectious diseases.

Of particular interest also is the further work carried out by Dr. Hamilton Fairley and Mr. R. J. Bromfield in connexion with a new blood pigment found in cases of blackwater fever.

In the Department of Entomology, research in regard to the conditions of temperature and humidity prevailing between the clothes and the body was accomplished in collaboration with the Anglo-Iranian Oil Company and may prove to be important in relation not only to the biology of lice and to outbreaks of diseases carried by these insects, but also to a better understanding of the adaptation of the human body to a wide range of climatic conditions.

Investigations in connexion with anti-larval oils were continued by Dr. D. R. P. Murray who had shown previously that the toxicity of such oils is of secondary importance to their penetration into the tracheal system of the larva. During the year under review this worker has confined his attention mainly to the "spreading pressure" of various oils and to the possibilities of improving the spreading capacity and film-stability of these by addition of substances which will not in addition produce undesirable effects. Dr. Murray's work is likely to be of considerable practical importance and may help much to explain the failure of oiling reported in certain areas.

The investigations into the biology of the bed bug, financed by the Medical Research Council and carried out by Mr. C. G. Johnson, were continued during the year and are yielding much additional information in regard to the life history of this insect which is likely to prove of value in its prevention.

In the Department of Bacteriology and Immunology, work in regard to the comparative nutritive value for calves of fresh and pasteurized milk was done, the results of which indicated clearly that pasteurized milk could not be considered inferior to fresh as far as calves were concerned. In this investigation Professor Wilson collaborated with Dr. F. C. Minett of the Royal Veterinary College, and Mr. H. F. Carling of the Berks and Bucks Sanatorium.

In the Division of Epidemiology and Vital Statistics much official or semi-official work was completed, particularly in connection with maternal mortality, cancer, mortality in the depressed areas and the incidence of sickness in transport workers. In regard to the latter it is interesting to note that since February 20, 1934, the incidence of sickness (particularly gastric) among omnibus drivers and conductors had been the subject of inquiry. In other words a careful investigation into the problem was begun three years at least *before* the strike at the time of the Coronation.

Much research of importance was continued during the year with reference to industrial physiology, and the special department concerned received considerable additional evidence of the value of reinforced aluminium foil for purposes of insulation.

In regard to air conditioning many tests on such units were carried out and in one particular instance a cubicle designed for one occupant, and furnished with a bed, chair and table, was subjected to very severe conditions of tropical heat and humidity and the tests proved that with a

relatively small conditioning unit such a room provides a comfortable refuge for rest and sleep.

One of these cubicles was demonstrated at the Manson-Ross Commemoration Reception and with outside dry and wet bulb temperatures of 100° F. and 90° F. respectively, the inside readings were 85° F. and 72° F. It is hoped as a result of this work portable cubicles and simple air conditioning units will shortly be available at moderate prices.

The Report emphasizes also that while under certain climatic conditions of dryness coupled with excessive heat a substantial drop in air temperature may be necessary, yet this may be overdone, and that in very humid climates it is of more importance to dehumidify the air than to cool it.

The Malaria Research Unit under Professor Sir Rickard Christophers continued interesting researches during the year and collaborated closely with the Ministry of Health Malaria Therapy Centre at Horton and with the Departments of Entomology and Protozoology at the School.

In the concluding pages of the Report information is given in regard to the Ross Institute of Tropical Hygiene, and in some interesting paragraphs on the teaching of tropical hygiene, stress is laid on the importance of realizing that in the tropics over 90 per cent of the people live in rural areas on food and other produce which they themselves grow, whereas 80 per cent of the population of England have no direct concern in agriculture, and that for many reasons a health officer in the tropics with even a slight knowledge of agriculture, soil fertility, soil biology, soil preservation, hydraulic engineering and physical geography and geology can be incomparably more helpful to farmer, planter or peasant than one without this knowledge, while a little knowledge of cattle and their diseases is also of much assistance in helping the health officer to gain the confidence of the natives.

Details are given in the concluding pages of the Report as to the work of the Ross Institute in India, and as to investigations carried out in other tropical countries, but space does not permit of any more detailed reference to these, although without exception they are of moment and interest.

The London Institute is attended in increasing numbers by laymen as well as members of the medical and veterinary professions, and it is difficult to exaggerate the value of the instruction and help it gives or to overestimate the saving in lives and improvement in health standards in the people of tropical countries, which it must directly or indirectly effect.

It is of interest finally to note in regard to the London School of Hygiene and Tropical Medicine as a whole that since the year 1930 some 1,231 medical officers from forty-eight countries have attended one or other of the courses of instruction held there, an adequate testimony to the world-wide regard and esteem in which the School is held.

The Report is one which must commend itself to all for its scientific interest and for the able manner in which the activities of the School for the year have been set out.

A.E.R.

**WARWICK AND TUNSTALL'S "FIRST AID" TO THE INJURED AND SICK.**  
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F. C. Nichols, M.C., M.B., Ch.B., M.R.C.S., L.R.C.P., L.D.S., late  
Captain, R.A.M.C. (T.). Bristol: John Wright and Sons, Ltd. 1937.  
Pp. xii + 318. Price 2s. 6d. net.

To have reached its sixteenth edition, as this handbook has, is a sure indication of the soundness of the book and its usefulness to workers in "First Aid."

The chief feature of the present edition of this well-known handbook on "First Aid" is the larger amount of space devoted to gas poisoning in warfare. The Chapter is based on the material in the official *Air Raids Precautions Handbooks* of the Home Office, and so is an authoritative description of the latest knowledge on the subject.

The book is primarily intended for the use of those lecturing on the subject of "First Aid," not to supersede medical or surgical treatment by a doctor, and it is obvious that it fully achieves that object.

It is excellently printed, copiously illustrated, has a most complete index, and is of a handy size. At the modest price of 2s. 6d. it is brought within the reach of all interested in this important subject.

An excellent book on "First Aid."

---

## Notices.

### THE ROYAL SANITARY INSTITUTE.

#### THE BUG NUISANCE.

IN view of the great attention which is being paid at the present time to the disinfestation of houses and furniture from the bed bug, the Royal Sanitary Institute has decided to hold a further course of instruction in disinfestation work. This course will commence on Monday, May 16, and will last for two weeks. Full particulars can be obtained from the Secretary of the Institute, 90, Buckingham Palace Road, London, S.W.1.

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#### MILK PASTEURIZATION.

IN view of the increasing number of pasteurizing plants, the Royal Sanitary Institute conducted during the winter of 1937-38 three courses of lectures and demonstrations for medical officers of health, sanitary inspectors and others interested in the subject of pasteurization. During the courses arrangements were made for those attending to see different kinds of plant in operation which proved very helpful to illustrate the difficulties to be overcome in practice.

It seemed evident that the demand for such courses was not fully met so it has been decided to hold a further course on Thursday and Friday, May 26 and 27.

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It is indicated for the treatment of such cutaneous disorders as eczema, seborrhœa, psoriasis, pruritis ani and pruritus vulvæ, etc.

## EIGHTH SESSION OF THE CONFERENCES OF THE INTERNATIONAL COMMITTEE OF MILITARY MEDICINE.

As already announced the Eighth Session of the International Committee will be held at Luxemburg from July 1 to 4, 1938.

The undermentioned Conferences of Military Medicine are already announced :—

*Belgium.*—(1) The selection of pilots in the light of the investigations of aeronautical medicine and physiology (Lieutenant-Colonel Sillevaerts).

*Chile.*—Sudden variations in atmospheric pressure as a cause of injury to the tympanum and labyrinth in the Artillery, Navy and Air Service (Lieutenant and First Surgeon of the Navy Dr. Ottmar Wilhelmig).

*United States.*—Medico-military statistics in time of peace and in war.

*Switzerland.*—The cure of soldiers in sanatoria (Major Voute).

*Yugoslavia.*—The tactical employment of surgical units in the field (Lieutenant-Colonel Branovatchky).

Besides the usual conferences on Military Medicine the Session this year will comprise :—

(1) A reunion of International Right organized by the International Law Association, which will discuss the legislation of aerial protection.

(2) A reunion of scientific studies of aerial protection.

(3) A demonstration of medical aviation.

For further information application should be made to Colonel T. Voncken, Liège, Belgium.

## MODERN PHOTOGRAPHIC DEVELOPMENT.

IN order to encourage amateur photographers to do their own developing and printing and thereby derive much more pleasure and interest from their hobby, Messrs. Burroughs Wellcome and Co. have issued a 24 page booklet. In it are explained, step by step, the successive stages of picture-making with the camera, and how, by employing "Tabloid" Photographic

Chemicals, the bugbear of weighing chemicals and preparing stock solutions can be eliminated. Not only do these products save time and trouble, but their use actually makes for more consistent results since developers and other photographic chemicals almost invariably deteriorate when kept in solution. The booklet "Modern Photographic Development" will be sent free and post free to readers of this journal. Application should be made to Burroughs Wellcome and Co., Snow Hill Buildings, London, E.C.1.

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### THE HEALTH CONGRESS OF THE ROYAL SANITARY INSTITUTE.

THE subjects to be discussed at this year's Congress, July 4 to 15, are the following :—

The future of the general hospital.

The defects found in school entrants, and the steps that might be taken to effect their remedy before the beginning of school life.

Behaviour and nervous disorders in children.

Clinics for the pre-school child.

The food manufacturers' contribution to public health.

The Food and Drug Bill, 1937.

Meat and food inspection.

The Tuberculosis (Attested Herd) Scheme.

Air raid precautions.

Propaganda and hygiene of indigenous races in the tropics.

The health of the worker.

The duration of incapacitating sickness.

Rheumatism.

The Housing (Rural Workers) Act.

Operation of the Housing Act, 1936.

Disinfection by diffusion screens.

Town planning.

Sea outfalls and disintegrator plants.

The drainage and plumbing of Earl's Court Exhibition.

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## EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

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Communications in regard to editorial business should be addressed—"The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."

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THE DISPOSAL OF SULLAGE WATER.

BY BREVET LIEUTENANT-COLONEL E. F. W. MACKENZIE, O.B.E., M.C.,

*Royal Army Medical Corps.*

AN officer of the Royal Army Medical Corps, when asked what, in his opinion, was the most satisfactory method for the disposal of sullage water from a camp of ten to fourteen days' duration, once replied, "This problem presents no difficulty whatever." This officer's experience can only be considered strictly limited or unusually fortunate. Undoubtedly there are times when the problem presents little or no difficulty but, in the experience of the writer, such occasions are comparatively rare and are greatly outnumbered by those in which the problem is almost insoluble.

The following quotations from the official History of the War, Medical Services, Hygiene of the War, Vol. I, illustrate the difficulties which arose at that time. "In certain home camps during the War . . . the liquids were dealt with by means of drains and by a system of surface irrigation. This is a satisfactory method of disposal provided that enough land was available, at least one acre per 1,000 troops, at a sufficient distance from the camp not to cause a nuisance in hot weather"; "Under certain conditions passage into streams or rivers was harmless, but frequently the streams had to be used for watering horses or bathing, and any gross pollution was therefore undesirable. Surface disposal of untreated sullage water created a nuisance, and soakage pits were generally unable to dispose of the large volume of liquid."

In times of peace the fouling of an acre per 1,000 troops, in areas scattered widely throughout the country, is usually out of the question,

and in countries where malaria prevails surface irrigation almost invariably leads to mosquito breeding. For that reason it has been largely discontinued, and we are faced with the alternative of putting waste water underground or of running it into a convenient ditch or stream. The former method is possible, and the latter permissible only if the sullage has been brought to a state of considerable purity by removal of grease and suspended matter before final disposal.

Herein lies the crux of the situation. Can any methods of treatment which will furnish a satisfactory effluent be made applicable to camps?

In the case of disposal into a stream the effluent must, in many cases, comply with statutory standards which can be attained only by chemical treatment. Attempts to apply chemical treatment by methods suitable for use in camps of moderate duration have been made recently at the Army School of Hygiene and are continuing. If successful these will be dealt with in a subsequent article.

In the case of disposal into the ground the sullage water need be purified only to such an extent that the contained grease and suspended matter in the effluent will not clog soakage pits or ditches, and render them impermeable in the time for which they will be required to function. In these circumstances, therefore, the requisite degree of purity is determined by variable factors, such as the permeability of the soil and the period for which the camp is likely to be occupied.

The annually recurring failure to dispose of sullage water from training camps throughout the country clearly demonstrates that our present methods are unsatisfactory or imperfectly applied, and that sullage water disposal may present greater difficulty than any other sanitary problem with which we are faced. It is, moreover, a matter in which failure becomes increasingly important since, year by year, more camps are provided with a piped water supply, while no attempt is made to install a system of drains to carry away the large quantities of waste water which inevitably result.

So long as it is necessary to draw water for camps from streams or ponds and to transport it, the supply is limited and the amount of sullage to be disposed of is inconsiderable. In situations where soakage is reasonably good the somewhat primitive methods of disposal adaptable to temporary camps suffice, if correctly applied.

The present tendency to supply all camps with a piped water supply creates an entirely different situation. The quantity of sullage water to be disposed of is almost unlimited and the logical corollary is a drainage system to carry away the waste. Unfortunately such a system involves a great deal more labour and expense than does the installation of a water supply, and however undesirable it may be, the anomaly of water laid on in situations where no drainage systems exist must be faced.

Circumstances vary widely in different localities and although the subject is comprehensively dealt with in official publications, the failures

which are seen on every hand may justify a repetition of much that is already known to many.

After so many years of research and with the immense experience of the War behind us, it would appear that something approaching finality has been reached. The suggestions to be made should therefore be regarded as little more than an endeavour to assist in applying old methods to the ever varying conditions with as much efficiency as can be achieved by attention to minor details and practical points, neglect of which so often results in failure.

Before putting forward any suggestions regarding the methods most suitable for use in different situations it will be of advantage to discuss the various processes and apparatus at our disposal. In doing so an attempt will be made to point out the limitations of each, the defects which commonly lead to failure, and to suggest, where our knowledge permits, minor modifications which may obviate these failures or extend the usefulness of the methods.

#### A.—TREATMENT OF SULLAGE WATER.

The methods available for treatment of sullage water are :—

(I) THE STRAINER TRAP.—This usually consists of a perforated tin or box placed over or near a soakage pit and filled with straw or brushwood.

Probably the best filling and one which is rarely used is hay, or newly cut grass, weighted down with large stones. In all cases the straining material must be removed and replaced frequently.

*Efficiency.*—This type of trap does no more than remove the coarse matter, such as potato peelings, bacon rind, etc., and a certain, though limited, quantity of solid grease. Its usefulness is therefore strictly limited. Its efficacy is increased in some degree if the sullage is led from the trap to the soakage pit in a surface channel, which also is packed with straining material, since this allows of some degree of cooling and further solidification of grease.

(II) THE COLD WATER GREASE TRAP.—The conventional pattern consists of a box furnished with three baffle plates, two floating baffles to hold back grease which rises to the surface, and between these a standing baffle which prevents sedimented matter from being swept through the trap by the incoming water. No advantage accrues from further multiplication of baffles. When constructed of wood its life is prolonged by treatment with solignum or creosote.

A grease trap of high efficiency and suitable for permanent installation is illustrated. It consists of a series of three chambers of suitable size with connecting pipes arranged to form seals as shown. The seals of the first and third chambers should extend to within 4 inches of the bottom; that in the middle chamber should extend not more than



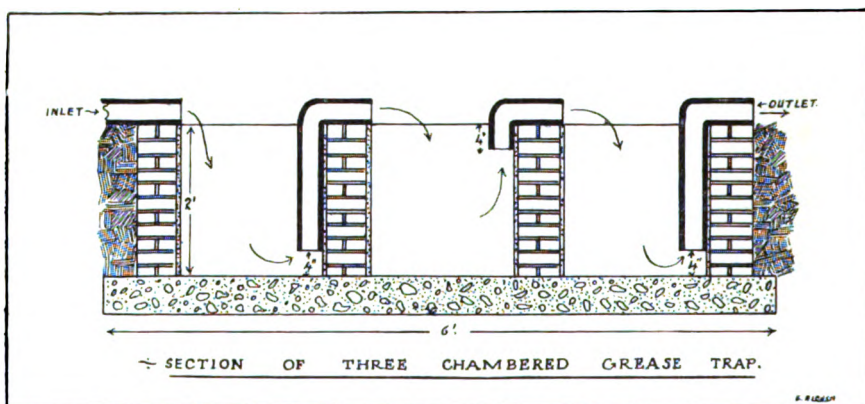
4 inches below the level of the water in the trap. The diameter of the pipes must be sufficient to carry the maximum flow.

A grease trap to work on this principle can easily be improvised from three petrol drums or barrels and a length of old piping.

A cold water trap has two important functions.

It must retain all grease which separates out and rises to the surface when the hot greasy water is cooled by admixture with the cold water in the body of the trap.

It must retain a considerable amount of suspended matter which is sedimented from the sullage while it is passing through the trap. An examination of an efficient trap in operation will show that the quantity of sediment retained is usually as great as, and may be greater than, the quantity of grease.



The capacity must therefore be sufficient to : (1) Bring about adequate cooling of the largest volume of hot water likely to be added at any one time ; (2) permit the necessary quantity of water to be added without excessive agitation, or flushing of grease or suspended matter through the trap.

The size of trap necessary under any given conditions thus depends upon : (1) Temperature ; (2) rate of flow through the trap. The latter is greatly influenced by the manner of delivery. If this alone is considered, a trap of fixed size will deal with a very much larger volume of water delivered by continuous flow than would be the case if the water were added in larger quantities at intervals.

In the case of temperature this difference is not marked, since the effect of adding hot water is cumulative and cooling during the intervals is so slight as to be unimportant. The relative importance of the two factors therefore varies under different conditions, and is difficult to assess in general terms.

It has been laid down that the volume of cold water in a trap should

be five times as great as the amount of water likely to be added at any one time and that the minimum capacity of any trap should be 50 gallons. These figures are conservative and the standards laid down in the Official History of the War furnish a more reliable guide. They are as follows: A cookhouse dealing with 100 men requires a trap holding 100 gallons, while for 600 men a trap holding from 250 to 300 gallons is suitable.

When considering this problem it must be remembered that cooling is influenced, not only by the quantity of the water added, but also by the frequency with which the additions are made. Blackmore (1932) clearly demonstrated this experimentally. He found that if a  $\frac{1}{4}$  litre of water at 40° C. were added to a 9 litre trap ( $\frac{1}{36}$  of its capacity) every five minutes, the rise of temperature was progressive.

The truth of the matter is that the larger the trap the greater will be its efficiency, and size should be limited only by difficulty in construction and by the tendency for traps of over 300 gallons capacity to be converted into cesspits.

Cold water grease traps should therefore be as large as circumstances permit and certainly never of a capacity less than the minimum laid down, which is 50 gallons. Any upper limit must be somewhat arbitrary, but the 250 to 300 gallons laid down in the Official History of the War furnishes a useful guide. Where greater capacity is essential traps must be duplicated.

The conventional design of grease trap already described is the most easily improvised and is satisfactory, provided attention is paid to the following points.

(1) Any one baffle should not occlude more than two-thirds of the transverse sectional area of the box. When water is added the rate of flow through the trap is proportional to the area through which it flows. If this area be too greatly restricted, the rate becomes sufficient to wash solids through the trap.

(2) The capacity of the trap must be adequate.

(3) The trap must receive regular attention in the shape of skimming, emptying, and cleansing as often as necessary—usually once or twice weekly. The baffles should be easily removable for this purpose.

(4) Soda should not be used for washing up.

The efficiency of a trap may be increased by cooling the incoming water before it reaches it. This can be done by placing the trap about fifteen feet from the cookhouse and leading the water to it in a galvanized iron half section drain.

Failure of traps of correct design is invariably due to inadequate capacity which results in flushing and insufficient cooling of the incoming water, or to neglect of cleansing.

*Efficiency*—The cold water grease trap, if correctly designed and managed, is efficient to the extent that it will remove completely all solid matter which rises to the surface in the form of grease and soapy scum, as

well as the heavier suspended matter. If suitable soil is available it will enable large quantities of sullage water to be disposed of by soakage into the ground.

The trap will not remove colloid, emulsified soaps and fats, or suspended solids of approximately the same specific gravity as water. These will pass through it and, except in localities where soakage is extremely good, will, after periods varying with the nature of the soil, lead to blocking of soakage pits.

In times of war the trap enables large quantities of fat to be recovered which would otherwise be lost. This is of national importance and a source of profit to the unit.

The use of a cold water grease trap involves a loss of head of only one or two inches, represented by the difference in height between the levels of the inlet and outlet. This fact, which is often forgotten, is of importance in situations where it is difficult to obtain sufficient fall to carry away the effluent.

(III) FILTRATION.—The briefest consideration of filtration as a method for the treatment of sullage water leads to the conclusion that any form of filter which does, in practice, remove the grease and suspended matter must, as a result of so doing, inevitably and rapidly become clogged. In spite of this apparently self-evident fact, filtration has not infrequently been advocated and experimental evidence has been obtained in support of statements to the effect that comparatively small filters are capable of purifying large quantities of sullage water. The writer has, in the past, carried out practical tests of filtration methods and has amply confirmed the obvious fact stated above.

Filters may, nevertheless, be usefully employed for final treatment after the bulk of suspended matter has been removed by other methods under the following circumstances.

Small filters may be used to purify further the effluent from a cold water grease trap before discharging it to a soakage pit. The simplest type consists of a container made from an oil drum or biscuit tin with the bottom perforated, in which one foot of sand or fine gravel is placed. The filter will become blocked in a time varying with the amount of particulate matter removed by it. It is therefore essential that the container shall be easily removable to facilitate emptying out the exhausted filter-bed, and that a considerable amount of material for replacement shall be readily available.

If these desiderata are not fulfilled any attempt at fine filtration will fail.

A filter may be employed successfully to extract the small fatty particles which are not carried down by the floc during chemical precipitation. Sand filters, wire gauze or canvas strainers and filtration through soil have all been successfully used for this purpose.

Any of the above methods may prove efficient, but careful supervision is essential.

An attempt has been made to devise a method of chemical treatment with subsequent removal of the floc by passage through a cold water grease trap in which a filter is incorporated (Blackmore, 1932). The results reported were highly satisfactory but were obtained under laboratory conditions with small models.

Prolonged experiments carried out by the writer under normal working conditions failed to confirm the results claimed. The amount of floc obtained from 1,000 gallons of average sullage water by chemical treatment is approximately 80 gallons. It is inconceivable that this could be retained in two compartments of the 50 gallon grease trap designed for the purpose, since the total capacity available is only 25 gallons and this is already largely occupied by filter material.

(IV) CHEMICAL TREATMENT.—During the War the methods already outlined, if correctly employed, gave an effluent which could be satisfactorily disposed of for short periods when the total amount was small, or when the soil was of such a nature that soakage took place under almost any conditions. Where these conditions did not exist the effluent, if passed into streams, caused gross pollution and if disposed of by surface irrigation, gave rise to nuisance.

It became imperative to devise some method of purification which would give a non-putrescible effluent free from suspended matter. This need was filled by chemical treatment, sedimentation, and subsequent filtration. The chemicals used for this purpose included alumino-ferric, chloride of lime, and nitre cake.

Chloride of lime produced a satisfactory effluent free from harmful bacteria, but shortage of powder and its expense prohibited its extensive adoption.

Slaked lime brought down the soap as insoluble calcium stearates and removed all suspended matter, but it was still necessary to remove the lime and oils by further treatment with washing soda involving several tanks and a complicated method of filtration.

Precipitation by alumino-ferric was simple in operation, but sludge disposal gave rise to considerable difficulty.

Nitre cake was discarded since special wagons were required for its transportation.

No further real progress in methods of treatment was recorded until recently, when Hattersley (1935) elaborated a satisfactory method of precipitation by means of ferrous sulphate. This process presents many advantages over those formerly in use.

Ferrous sulphate is a regular ordnance supply under the name "iron sulphate, commercial, green copperas." It is so cheap that the cost is negligible, being approximately one-fifth to one halfpenny per 100 gallons treated. The sludge settles rapidly and, if lagooned when drawn off, it causes no offence and does not attract flies. A further advantage lies in the fact that the sludge dries rapidly and, possibly as a result of its fat

content, does not again take up appreciable quantities of moisture, even in wet weather.

The method may be considered superior to those in previous use, and a full description will be found in Hattersley's original publication.

We have, then, a simple, cheap and efficient method for the treatment of sullage water. What are its limitations? Any process employing chemical precipitation involves the collection of sullage in receptacles in which it must remain for a sufficient time to permit of sedimentation, either by quiescent or continuous flow methods. Hattersley employed quiescent sedimentation in a concrete tank of 1,000 gallons capacity. Thompson (1937) later designed a small and ingenious continuous flow apparatus which incorporates automatic feeding of chemicals. Both methods involve considerable concrete and other constructional work. Each is suitable for use as a permanent installation in barracks, where no drainage system and sewage works exist, but neither method is applicable to camps.

#### B.—DISPOSAL OF SULLAGE WATER.

(I) SOAKAGE PITS.—The standard soakage pit is 4 by 4 by 4 feet. The pit is filled with stones, rubble or burnt out crushed tins to within six inches of the top. A layer of sacking is then laid over the top and the turf may be replaced. This makes the pit less unsightly and helps to keep out mosquitoes. When a large soakage area is required the pits should be duplicated, since this involves less labour than digging one bigger pit. When a pit ceases to soak through clogging with soap or fat, it is a common practice to dig it out, scrape the sides and refill the pit. This procedure is laborious and unsatisfactory. A second pit should be dug and a connecting pipe of large bore sunk a few inches underground to conduct the overflow from the top of the first pit to the second. A suitable pipe may be made by rolling up a flattened piece of corrugated iron. If necessary a third pit may be connected up in such a manner that the water passes through the pits in succession. If this method is used it will be found that purification takes place in each pit, and that where soakage is moderately good two or perhaps three pits in series will function indefinitely, although one may have failed in a comparatively short time.

In siting soakage pits it should be remembered that an impermeable stratum exists at a variable distance below the surface, on top of which the subsoil water lies. If drainage from this stratum is poor and heavy rains take place, or large quantities of water are disposed of by the pit, a rise in subsoil water level may occur which is sufficient to affect seriously the capacity of the pit. When a choice of sites exists pits should, for this reason, be placed on a slope where there is every reason to expect that subsoil drainage will be good.

(II) THE IRISH DRAIN.—Where an impermeable stratum exists near the surface, better results may be obtained by the use of an "Irish drain" either in place of, or supplementary to, a soakage pit. The drain consists

of a trench with a slight fall filled with rubble or stones in the same manner as is the soakage pit. If possible a site should be chosen where there is a natural fall, but if this is not available a fall can be obtained for a short length of trench by gradually increasing the depth. The sullage water percolates through the drain, soaking away through the bottom and sides.

The method is particularly useful where an impermeable layer is covered by two or three feet of loam. Similarly the drain may be used to take the overflow from a blocked pit in place of the series of pits described above.

On pure clay soil soakage will not take place and pits can be of service only as sumps for collecting water. In such situations they should, therefore, not be filled with stones or other material. The soil removed may be used to build a small wall to prevent people from falling into the pits at night.

*Efficiency* : In suitable soil soakage pits will dispose of large quantities of sullage water, but it must be understood that no soil, however porous, will absorb an indefinite quantity of water containing fat and soap. Their prolonged efficiency is, therefore, dependent upon the degree to which these substances are removed before passing the sullage into the pits.

When soakage is poor their capacity is strictly limited and soakage pits are of no value as such in impermeable strata, such as clay. This would appear obvious, but is frequently forgotten.

The same limitations apply to the Irish drain.

(III) SURFACE IRRIGATION.—Disposal by surface irrigation has long been used, and the herring-bone system of trenches is commonly employed. It has the following advantages over subsoil irrigation by means of Irish drains.

It is easier to construct. In the event of blockage by grease new surfaces can be secured by merely scraping away the old. It may be successful in places where a comparatively shallow layer of loam overlies an impermeable stratum.

In tropical countries there is a natural reluctance to put underground water that may be used for gardens which increase the amenities of barracks and furnish a supply of green vegetables and fruits, often deficient in the ration and of the utmost benefit to the health of the troops. If water is to be used for this purpose it must be collected in well-made surface drains, by which it is conveyed to the disposal area. This area must be divided up into sections and the drains constructed in a manner which allows the water to be cut off from any section as required, thus facilitating mosquito control by drying the irrigated areas in rotation.

The following experience illustrates the necessity for the most careful control of surface irrigation :—

A system was constructed for the disposal of sullage water from new Indian lines. The first regiment to occupy the lines was composed, for

the greater part, of agriculturists. The Commanding Officer was enthusiastic and knowledgeable. The system was in every way satisfactory, and in one year a barren slope was converted into pleasant gardens with great benefit to the dietary of the occupants. The regiment moved and was replaced by one of which neither the Commanding Officer nor the men were interested in gardens. A subsequent visit to the station provided something of a shock to the originator of the system. The whole area had become a mosquito breeding swamp, and only immediate and energetic action prevented a serious outbreak of malaria in the lines concerned.

It may be argued that the unit should have been compelled to exercise adequate supervision, but, on the whole, it is safer and easier to avoid this necessity by putting the water underground, even at a considerable sacrifice in other directions.

*Efficiency.*—Under conditions approaching the ideal and provided constant supervision is assured, surface irrigation may be successfully employed for sullage water disposal. This is particularly the case when it is preceded by chemical treatment to ensure a satisfactory effluent. If the system is to be permanent the land will usually require to be underdrained.

The method suffers from the following disadvantages:—

A slope of sufficient gradient to carry the water along slowly, but not so steep as to cause rapid passage of the water through the soakage channels, must be available if the herring-bone system is to be employed. This disadvantage can be overcome to some extent by substituting the catch-water method in which drains are carried along contours on the face of a slope in such a manner that the overflow from one passes over the surface of the ground before being picked up by the next.

The formation of gardens not infrequently leads to such enthusiasm that when the water supply is a piped one, taps are left running in order to furnish an ample supply of sullage water for agricultural purposes. Water consumption, therefore, becomes excessive.

In malarious countries constant supervision is imperative if mosquito breeding is to be prevented.

In the case of sullage from European lines preliminary chemical treatment is demanded by the high content of soaps and fats. These otherwise decompose; the resulting fatty acids give rise to offence and souring of the soil which, if crops are to be grown, must be treated with lime and allowed to lie fallow. The labour involved is considerable, and this, together with the fact that a large area of land is required, practically rules out the method so far as camps in the British Isles are concerned.

The desirability or otherwise of surface irrigation as a means of disposing of sullage water is, therefore, a problem which can be decided only after careful consideration and with complete knowledge of local conditions.

(IV) DISPOSAL OF SULLAGE WATER BY CARTING.—When a camp is established on clay soil with no possibility of soakage and with no slope to

permit of surface drainage, or where a slope exists but the camp is of a duration too short to permit of chemical treatment, there appears to be no alternative to carting away the sullage water for final disposal. This method is expensive, requires constant supervision, and is often imperfectly carried out. This is well illustrated by the case of a cantonment, the sullage water of which was carried by surface drains to concrete sumps behind the buildings. From the sumps it was baled into bullock-drawn tanks and was presumed to be removed to a lagooning area outside the cantonment during the early hours of the morning. Suspicion was first aroused by the presence of foul greasy areas which were noticed around the trees in the immediate neighbourhood of barracks. Water was laid on to the cantonment from a modern plant and the amount consumed could be ascertained. A short calculation involving the probable amount of sullage water, the number of tanks in use, the time occupied in filling and emptying the tanks and the average distance to the lagooning area produced the astonishing fact that each bullock must have travelled at a speed in the neighbourhood of one hundred miles per hour.

#### PRACTICAL APPLICATION OF METHODS.

An attempt will be made to summarize under a few headings the different conditions which are commonly met with in practice. While it is fully realized that the situations so created cannot, of necessity, cover all or even the majority of those which may be encountered, it is felt that combinations or modifications of the methods suggested, particularly if applied with due consideration of the details already emphasized, should enable any situation to be met with the maximum efficiency consistent with our present knowledge. A correct appreciation of the situation will help to eliminate failures which so often arise as the result of employing methods totally unsuited to existing conditions.

It must be remembered that no method of sullage water disposal has yet been, or is likely to be introduced, which does not require careful and constant supervision by somebody who possesses sufficient knowledge to advise regarding modifications of apparatus or alterations in procedure necessitated by minor circumstances which had not been foreseen.

#### A.—CAMP OR BIVOUAC OF SHORT DURATION.

*Note.*—No definite period is stated since the duration of a camp, when considered from the viewpoint of sullage water disposal, should be assessed in terms of the porosity of the soil and the quantity of sullage to be disposed of, rather than in units of time.

In this case a piped water supply is unusual and the quantity of sullage to be disposed of is limited by the necessity for carting all water.

(1) *Where Soakage is Good.*—The standard method: Soakage pits after preliminary passage through a strainer trap will suffice. This must be functioning on the first day after arrival in camp. More elaborate



arrangements are undesirable, as the time available is short, and are usually unnecessary.

In order to avoid immediate fouling of the camp site, temporary shallow pits must be dug to take waste water pending completion of the above arrangements.

(2) *Where Soakage is Poor.*—The best use must be made of existing soakage capacity. Cold water grease traps must be improvised and interposed between strainer traps and soakage pits. In extreme cases soakage pits become mere sumps and rapidly fill up. If the pits are filled with stones, etc., as laid down, their capacity is further limited and they overflow almost at once. Where bad soakage is anticipated, open pits should be used in duplicate. It is frequently found that considerable fall in water level takes place during periods of rest.

If, on digging a pit, it is found that only the upper part of the walls is permeable and that a clay subsoil exists, Irish drains should be substituted for pits.

(3) *Where no Soakage will take place.*—In such a situation we are faced by the following alternatives: (a) The effluent from grease traps may be run into a stream or ditch, provided one is handy and such a procedure will cause no legal offence and no nuisance. The method is therefore limited to camps of very short duration and at some distance from habitations. It is practically precluded in the British Isles. (b) The sullage water may be carted to a remote area. (c) The sullage water may be lagooned in a natural depression or in a shallow lake specially constructed for the purpose. This procedure inevitably gives rise to some offence.

There is no other solution, since chemical treatment is quite impracticable in camps of very short duration. For these and other reasons connected with general health and comfort clay sites should be avoided unless there is no alternative.

#### B.—A CAMP OF MODERATE DURATION OR SEMI-PERMANENT IN NATURE.

Water is laid on by piped supply to the majority of camps of this type. The quantity of sullage water to be disposed of is consequently large.

(1) *Where Soakage is Good.*—Strainer traps, cold water grease traps and soakage pits will, if correctly designed and managed, dispose of large quantities of sullage water. If difficulty, which is not due to mismanagement, is experienced soakage pits in series may provide the solution.

Where a good layer of loam is underlaid by clay or rock, soakage pits should be replaced by Irish drains. If pits have been constructed and have failed, the overflow from them may be led into Irish drains. The latter procedure has the effect of using pits in series and greatly prolongs the life of the new soakage area provided.

(2) *Where Soakage is Poor or Altogether Lacking.*—If sullage water is led into a ditch or small stream it is only a question of time before it will give rise to offence. In this case there are the following alternatives:—

(a) *Carting*. Owing to the large amount to be removed this will result in incomplete removal or the expense will be prohibitive.

(b) *Chemical Treatment*. The effluent may be run into a stream by existing rain-water channels and the sludge disposed of by lagooning or carting.

(c) *Dynamiting*. When lack of soakage is attributable to a shallow stratum of rock or clay, dynamite may be used to rupture the impermeable layer and so bring about a moderate degree of soakage from the bottom of the pit.

#### ACKNOWLEDGMENT.

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## CHEMICAL TREATMENT OF SULLAGE WATER WITH FERROUS SULPHATE AND LIME.

BY MAJOR T. F. KENNEDY, O.B.E.

*Royal Army Medical Corps.*

As a result of difficulties experienced in the Aldershot Command in the disposal of sullage water from camps during manœuvres, where the sub-soil happened to be clay, it was decided to try whether the chemical method of treatment of sullage water with ferrous sulphate and lime might be adapted for camps.

Preliminary investigation was carried out at the Army School of Hygiene to ascertain whether the 1,500 gallon canvas tank would be a suitable receptacle in which to carry out the treatment. The report obtained was entirely satisfactory, so it was arranged to erect four 1,500 gallon canvas tanks in one of the Standing Camps to be occupied by the troops for the 1937 Tattoo.

Camp No. 47 was chosen, as the gradient from the cook-house and ablution centres was sufficient to permit the tanks being filled by gravity flow. There were 453 men in camp. The tanks were erected side by side at ground level and the sullage water was led to them by a pipe with a branch-arm to each tank. (The piping was laid for convenience so as to avoid the digging in of the tanks.) Each branch-arm was fitted with a plug so that the flow could be diverted to any tank as required.

The tanks were used in rotation and it was found that about 1,300 gallons was the amount which could be comfortably treated without risk of spillage when the mixing of the chemicals was carried out. This mixing was done with a specially constructed wooden stirrer with rubber round the edges which prevented injury to the canvas during the process of stirring.

The routine adopted in the treatment of a filled tank was as follows :—

(a) A fixed amount of  $5\frac{1}{2}$  lb. of ferrous sulphate, dissolved in boiling water, was added at each treatment of each tank.

(b) Lime, slaked and stirred up in water was then added little by little until the proper floc began to form.

(Note.—During the adding of the lime the water in the tank must be kept well agitated with the wooden stirrer so as to ensure even mixing of the contents.)

(c) The tank was allowed to rest and the floc to settle for half an hour.

(d) The contents of the tank were again thoroughly agitated with the wooden stirrer.

(e) The tank was allowed to rest and the floc to settle finally.

(f) Clear supernatant fluid was syphoned off and the sludge at bottom of tank allowed to remain.

The water can be syphoned off to within an inch or so of the top of the sludge. The depth of the sludge varies with the number of successive treatments that have taken place in the tank without de-sludging. Each treatment adds approximately half an inch depth of sludge.

(g) The sludge was allowed to remain and fill up again.

It was found that the time required for the floc to settle down after the second stirring diminished considerably with each successive treatment in the tanks up to the fourth, after which it remained constant. The time required for the floc to settle in the first treatment was three and a half hours from the second stirring, in the second and third treatments three hours, and in the fourth and succeeding treatments two hours.

The maximum number of treatments carried out in any one tank without de-sludging, was fourteen, and the height of the sludge was then  $9\frac{1}{2}$  inches (see Tank 4 at Appendix "D").

The sludge can be syphoned off when required and lagooned. It is perfectly innocuous and needs no treatment.

Samples of the effluent, syphoned from the tanks, were taken at intervals and sent for examination. The results were as follows :—

#### MAY 26 AND 28, 1937.

Tank No.				1	2	3	4
pH	..	..	..	8.2	9.6	9.2	9.4
Suspended solids	..	..	..	2.6	1.4	1.8	1.7
Dissolved oxygen absorbed	..	..	..	With the normal dilution of 1.5 there was no dissolved oxygen remaining after five days at 18° C.			

#### JUNE 4, 1937.

Tank No.				1	-	-	4
pH	..	..	..	8.2			8.8
Suspended solids	..	..	..	Less than 1.0 per 100,000			Less than 1.0 per 100,000
Oxygen absorbed from aerated tap water at 18° C. in five days				Nil remaining (Dilution 1:10)			4.26 per 100,000

#### JUNE 9, 1937.

Tank No.				-	2	3	-
pH	..	..	..		9.0	8.2	
Suspended solids	..	..	..		Less than 1.0 per 100,000	1.4	
Oxygen absorbed from aerated tap water at 18° C. in five days					7.33	6.16	

It will be noted that the oxygen absorbed figure may not fulfil the requirements of an effluent laid down by Royal Commission. It is thought that this is due to absorption of oxygen caused by oxidation of the ferrous sulphate in solution.

This certainly detracts from the value of the process and unless it can be overcome may prevent it from being adopted in certain cases where the dilution of the effluent at its discharge into a river is less than 150 volumes.

It was found that 5·7 gallons of water per head per day were used throughout the period of the camp.

The hours of the peak load were at night when the men washed and used the showers on returning to camp after the Tattoo performance and over four gallons per man were used during this time.

It was noted that one tank and a half were sufficient to take this load and that three tanks would have more than sufficed for the camp.

Allowing four gallons per man as the peak load likely to occur at any time, a total of three tanks would suffice for 650 men.

The cost of the chemicals used works out at a fraction over 5d. per 1,000 gallons.

The canvas material of the tanks was stained brown by the action of the chemicals. The stain could not be removed by scrubbing, but no other harmful effect was noted.

#### CONCLUSION.

The treatment of sullage water in camp by sedimentation with ferrous sulphate and lime in 1,500 gallon canvas tanks should be a perfectly practical proposition if the effluent flows into a river in which it is diluted by 150 volumes or over. Should the dilution be less than 150 volumes then some treatment of the effluent would be required to reduce its oxygen absorptive powers to two parts by weight per 100,000 at which figure it may be allowed to run waste without fear of river pollution.

*Note.*—Since this report was written, experiments have been carried out at the Army School of Hygiene by Lieutenant-Colonel E. F. W. Mackenzie, O.B.E., M.C., R.A.M.C., and it has been found that the ferrous sulphate in the effluent quickly becomes oxidized in contact with the air. If the effluent is run over, a shallow weir the oxygen absorbed figures become considerably reduced and, if still above two parts by weight per 100,000, can readily be brought within the standard by chlorination.

## APPENDIX "A."—TREATMENT OF SULLAGE WATER IN CANVAS TANKS BY FERROUS SULPHATE AND LIME.

## TANK NO. 1. FIRST PERIOD.

Treat-ments	Date	Time of treatment	Amounts		Inches of sludge left after treatment	No. of men in camp	Amount of water in tank	Sample of effluent taken at	Time of syphonage
			FeSO <sub>4</sub>	Lime					
1	22.5.37	11.00 a.m.	5½ lb.	6 lb.	¾ in.	366	1,300 gals.	—	4.30 p.m.
2	24.5.37	9.30 "	5½ "	5 "	1 "	453	1,300 "	—	2.00 "
3	27.5.37	9.00 "	5½ "	6 "	1½ "	453	1,300 "	2.30 p.m.	2.30 "
4	29.5.37	9.30 "	5½ "	7½ "	2½ "	453	1,300 "	—	1.30 "
5	31.5.37	9.00 "	5½ "	6 "	2½ "	453	1,300 "	—	2.00 "
6	2.6.37	10.00 "	5½ "	6 "	3 "	453	1,300 "	—	2.00 "
7	3.6.37	9.30 "	5½ "	6 "	3½ "	453	1,300 "	2.00 p.m.	1.30 "
8	5.6.37	10.00 "	5½ "	6 "	4 "	453	1,300 "	—	2.00 "

*Tank sludged on 6.6.1937.*

## SECOND PERIOD.

1	6.6.37	10.00 a.m.	5½ lb.	9 lb.	1½ in.	453	1,300 gals.	—	2.00 p.m.
2	9.6.37	9.00 "	5½ "	8 "	2 "	453	1,300 "	—	2.00 "
3	10.6.37	10.00 "	5½ "	8 "	2½ "	453	1,300 "	—	2.00 "
4	12.6.37	3.00 p.m.	5½ "	7½ "	3 "	453	1,300 "	—	9.00 a.m.
5	14.6.37	10.00 a.m.	5½ "	6 "	3½ "	453	1,300 "	—	2.00 p.m.
6	15.6.37	9.00 "	5½ "	6 "	4½ "	453	1,300 "	—	1.30 "
7	17.6.37	9.30 "	5½ "	6 "	5 "	453	1,300 "	—	1.30 "
8	20.6.37	10.30 "	5½ "	6 "	5½ "	453	1,300 "	—	3.00 "

*Final sludging on completion of Camp, 21.6.1937.*

## APPENDIX "B."—TREATMENT OF SULLAGE WATER IN CANVAS TANKS BY FERROUS SULPHATE AND LIME.

## TANK NO. 2. FIRST PERIOD.

Treat-ments	Date	Time of treatment	Amounts		Inches of sludge left after treatment	No. of men in camp	Amount of water in tank	Sample of effluent taken at	Time of syphonage
			FeSO <sub>4</sub>	Lime					
1	22.5.37	11.20 a.m.	5½ lb.	7 lb.	1 in.	366	1,300 gals.	—	5.00 p.m.
2	25.5.37	9.30 "	5½ "	6 "	1½ "	453	1,400 "	2.00 p.m.	2.00 "
3	27.5.37	9.30 "	5½ "	6 "	1½ "	453	1,300 "	—	2.00 "
4	29.5.37	9.30 "	5½ "	6 "	2 "	453	1,300 "	—	2.00 "
5	31.5.37	9.30 "	5½ "	6½ "	2½ "	453	1,300 "	—	1.30 "
6	2.6.37	10.00 "	5½ "	6 "	2½ "	453	1,300 "	—	2.00 "
7	3.6.37	9.30 "	5½ "	6 "	3½ "	453	1,100 "	—	2.00 "
8	6.6.37	9.00 "	5½ "	6 "	4½ "	453	1,300 "	11.00 a.m.	1.30 "
9	8.6.37	10.00 "	5½ "	6 "	5 "	453	1,300 "	—	2.00 "
10	10.6.37	9.00 "	5½ "	6 "	5½ "	453	1,300 "	—	2.00 "
11	11.6.37	11.00 "	5½ "	6 "	6½ "	453	1,300 "	—	9.00 a.m.
12	12.6.37	9.30 "	5½ "	6 "	7 "	453	1,300 "	—	12.6.37 3.30 p.m.

*Tank sludged 13.6.37.*

## SECOND PERIOD.

1	14.6.37	11.00 a.m.	5½ lb.	6 lb.	Sludged 13.6.37	453	1,300 gals.	—	3.00 p.m.
2	16.6.37	9.00 "	5½ "	6 "	½ in.	453	1,300 "	—	1.00 "
3	17.6.37	10.00 "	5½ "	6 "	¾ "	453	1,300 "	—	2.30 "
4	19.6.37	10.30 "	5½ "	6 "	1½ "	453	1,300 "	—	2.30 "

*Final sludging on completion of Camp, 21.6.1937.*



## APPENDIX "C."—TREATMENT OF SULLAGE WATER IN CANVAS TANKS BY FERROUS SULPHATE AND LIME.

TANK No. 3. FIRST PERIOD.

Treat-ments	Date	Time of treatment	Amounts		Inches of sludge left after treatment	No. of men in camp	Amount of water in tank	Sample of effluent taken at	Time of syphonage
			FeSO <sub>4</sub>	Lime					
1	22.5.37	11.50 a.m.	5½ lb.	7 lb.	¾ in.	366	1,300 gals.	—	8.30 a.m.
2	23.5.37	9.30 "	5½ "	6 "	1 "	453	1,300 "	—	2.00 p.m.
3	24.5.37	10.00 "	5½ "	6 "	1¼ "	453	1,300 "	2.30 p.m.	2.30 "
4	27.5.37	9.30 "	5½ "	6 "	1½ "	453	1,300 "	—	2.00 "
5	28.5.37	10.00 "	5½ "	6 "	2 "	453	1,350 "	—	2.30 "
6	30.5.37	9.30 "	5½ "	6 "	2¾ "	453	1,400 "	—	2.00 "
7	2.6.37	9.30 "	5½ "	6 "	3½ "	453	1,300 "	—	2.00 "
8	5.6.37	9.00 "	5½ "	6 "	4½ "	453	1,300 "	--	1.30 "

Tank sludged on 5.6.37.

SECOND PERIOD.

1	7.6.37	9.30 a.m.	5½ lb	8 lb	½ in.	453	1,300 gals.	—	1.30 p.m.
2	9.6.37	10.00 "	5½ "	8 "	1 "	453	1,300 "	11.30 a.m.	—
3	11.6.37	10.00 "	5½ "	7½ "	1½ "	453	1,300 "	—	2.30 p.m.
4	12.6.37	9.00 "	5½ "	7½ "	2 "	453	1,300 "	—	1.00 "
5	14.6.37	10.30 "	5½ "	6 "	2½ "	453	1,300 "	—	2.30 "
6	15.6.37	9.30 "	5½ "	6 "	3 "	453	1,400 "	—	2.00 "
7	18.6.37	10.30 "	5½ "	6 "	3¾ "	453	1,400 "	—	2.30 "
8	20.6.37	10.00 "	5½ "	6 "	4½ "	453	1,300 "	—	2.00 "

Tank finally sludged on 21.6.1937.

## APPENDIX "D."—TREATMENT OF SULLAGE WATER IN CANVAS TANKS BY FERROUS SULPHATE AND LIME.

TANK No. 4.

Treat-ments	Date	Time of treatment	Amounts		Inches of sludge left after treatment	No. of men in camp	Amount of water in tank	Sample of effluent taken at	Time of syphonage
			FeSO <sub>4</sub>	Lime					
1	24.5.37	10.00 a.m.	5½ lb.	7½ lb.	1 in.	453	1,400 gals.	—	2.30 p.m.
2	26.5.37	11.30 "	5½ "	6 "	1¼ "	453	1,300 "	9.30 a.m.	9.30 a.m.
3	27.5.37	2.00 p.m.	5½ "	6 "	1½ "	453	1,300 "	27.5.37	27.5.37
4	28.5.37	9.30 a.m.	5½ "	6 "	2 "	453	1,300 "	—	2.00 p.m.
5	30.5.37	10.00 "	5½ "	8 "	¾ in.	453	1,300 "	—	2.30 "
6	1.6.37	9.30 "	5½ "	7 "	1 "	453	1,300 "	1.30 p.m.	1.30 "
7	3.6.37	10.00 "	5½ "	7 "	2 "	453	1,300 "	—	2.00 "
8	5.6.37	9.30 "	5½ "	7 "	3 "	453	1,300 "	—	2.00 "
9	7.6.37	9.30 "	5½ "	6½ "	3½ "	453	1,300 "	—	1.30 "
10	8.6.37	9.30 "	5½ "	6 "	4¼ "	453	1,300 "	—	2.00 "
11	10.6.37	10.00 "	5½ "	6 "	5 "	453	1,400 "	—	2.30 "
12	11.6.37	9.30 "	5½ "	6 "	5½ "	453	1,300 "	—	2.00 "
13	13.6.37	11.30 "	5½ "	6 "	6½ "	453	1,300 "	—	3.30 "
14	14.6.37	10.00 "	5½ "	6 "	7 "	453	1,300 "	—	2.00 "
15	15.6.37	10.00 "	5½ "	6 "	7¾ "	453	1,250 "	—	2.00 "
16	17.6.37	9.30 "	5½ "	6 "	8½ "	453	1,250 "	—	2.00 "
17	18.6.37	9.00 "	5½ "	6 "	9 "	453	1,200 "	--	1.30 "
18	20.6.37	9.00 "	5½ "	6 "	9½ "	453	1,100 "	--	1.00 "

Tank sludged 21.6.1937.

## FEVERS OF THE TYPHUS GROUP IN THE BHIM TAL AREA, KUMAUN HILLS, U.P., INDIA.

BRING A REPORT OF AN INVESTIGATION CARRIED OUT INTO THE  
ALLEGED INCIDENCE AND NATURE OF TYPHUS GROUP FEVERS IN  
THE BHIM TAL AREA, KUMAUN HILLS, JULY, 1936.

BY CAPTAIN BASIL BLEWITT,  
*Royal Army Medical Corps.*

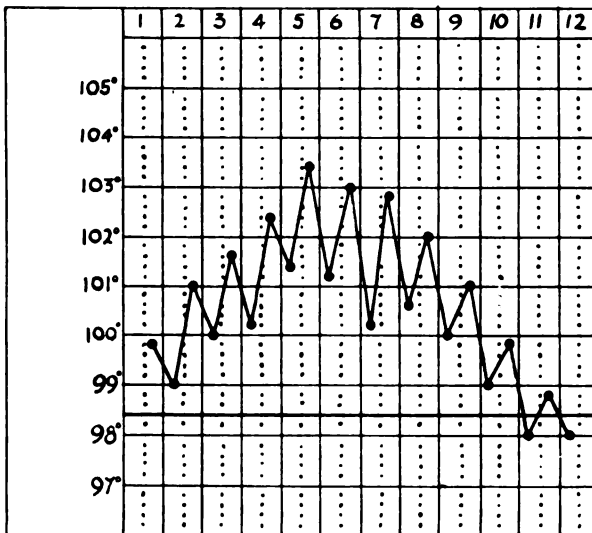
(Continued from p. 315).

### IV.—WHAT IS THE EVIDENCE IN SUPPORT OF MEGAW'S PRIMA FACIE CASE AGAINST THE TICK AND DOES IT JUSTIFY THE ABANDONMENT OF THE PRIMA FACIE CASE AGAINST THE LOUSE?

The evidence in support of Megaw's contention may be divided into  
three parts :—

- (1) Megaw's evidence.
- (2) The statements of the more recent cases from the area.
- (3) The analogy with Rocky Mountain Spotted Fever.

#### (1) *Megaw's Evidence.*



*Case 7.*—(Megaw's case.) Lucknow, July, 1916. Widal eleventh and ninth day negative. Marked rash fifth day. Headache, joint pains, lethargy, rapid recovery.

When in 1917 Megaw introduced this theory there was only his own case with a definite history of a tick-bite before the onset of the fever. In



1921 he secured another case from Bangalore (South India), and in 1928 a further three cases. From 1913 to 1936 of the 177 recorded cases only sixteen had a history of a tick-bite prior to the onset (Shortt and D'Silva, 1936). It must be noted that in none of the cases from the Kumaun Hills, with the exception of Megaw's, is there a definite history of a tick-bite prior to the onset. As regards the Kumaun there is therefore only recorded evidence of one case. Bearing in mind our knowledge of the epidemiology of typhus in the Kumaun and the circumstances associated with Megaw's infection—he stopped in the Dak bungalows and was exposed to a louse-infested population—it seems not improbable that he picked up an infected louse or lice while passing through the hills. This seems a much more reasonable hypothesis in view of all the circumstances than the immediate assumption that the disease was conveyed by a tick. Certainly the evidence of the last twenty-three years has little to support the tick theory.

(2) *The statements of some of the more recent cases from the area.*

(i) *Helleyer*.—"I attribute my illness to having been bitten to death by ticks whilst sitting on the side of the lake at Bhim Tal." (Statement made to a friend before death.)

(ii) *Massey*.—"There was at the Manse a semi-wild cat. Helleyer frequently found this cat on his bed and it used to haunt his bedroom. It is probably pure imagination, but I have always had a feeling that the cat was responsible for Helleyer's death and my illness. That cat used to shed ticks on Helleyer's bed, and on one occasion on which I found it in my room it did the same." (Personal letter.)

(iii) *Starling*.—"My own beliefs are : (a) I was bitten on the left calf by a tick or other insect in the Malwa Tal—Bhim Tal area. (b) These ticks are only active and dangerous in the rains."

Taken on its face value this evidence would undoubtedly seem to incriminate the tick. On closer investigation it is evident that it is not as reliable as might be inferred.

Firstly as regards Helleyer's statement. It must be a very rare experience to be "bitten to death by ticks." It is much more likely he was bitten by midges, mosquitoes or the small red ants which abound along the side of the lake. He was obviously badly bitten all over his body and this would not be in accord with tick bites, but with fleas, lice, midges or mosquitoes. It is common to find one, or possibly three or four ticks attached to a person, but they are never found all over the body—Helleyer does not say he found any, which he should have done if they had been ticks. It is the uniform experience of anyone to be badly bitten by insects when sitting at a lakeside at this season of the year and it is highly improbable that his experience was in any way associated with his disease. It is much more likely that he contracted the infection as suggested by his friend Massey at the Manse.

Secondly as regards Massey's statement: There is every reason to agree with his view that he and Helleyer contracted the fever at The Manse where Sharp, when in occupation, had been taken ill. It seems most improbable, however, that their joint attacks were in any way associated with the ticks "shed" by the semi-wild cat. It is very doubtful if the cat did actually shed ticks—Massey only assumed it shed ticks. If it shed any insects they would more likely be fleas. The possibility of the flea as a vector will be referred to later, sufficient to say that Massey makes no reference to fleas and our knowledge of these fevers in the area and Sharp's attack suggest the louse as the more probable vector.

Thirdly, as regards Starling's statement: There is no reason to infer that the bite on his calf was a tick bite (Starling found no tick) or in any way associated with his subsequent infection. Such bites are the common experience of everybody at this season of the year; they are usually scratched, become septic and are surrounded by an area of inflammation. But there is no particular reason to assume they are tick bites or that subsequent illnesses are in any way associated with them, more particularly when the illness is typhus and has occurred in a person exposed to louse-infested natives in an area in which typhus is endemic.

It is natural to wonder why the tick has been given such a sinister role in the epidemiology of such cases. The answer is, of course, quite clear: they were all informed in hospital that they were suffering from "tick typhus" which was common in the area. When one is so informed by one's medical attendant, it is not unnatural to accept the verdict of the expert and to try and recollect some incident in one's recent movements to confirm what one accepts as having happened. This, of course, explains the whole case against the tick. In support of these remarks we have the statement of Massey when pressed as to why he had thought of a tick, "I believe I was infected by a tick because I was told in hospital at Meerut that I was suffering with tick typhus." Starling's remarks with reference to the seasonal tick danger reveals a preconceived prejudice. One cannot help wondering what evidence might have resulted if these cases had been told they were suffering from "louse typhus."

### (3) *The Analogy with Rocky Mountain Spotted Fever.*

It will be obvious from the foregoing remarks that no theory could be maintained on the evidence of one case, and there is only one case from the Kumaun in the past twenty-three years with a history of a definite tick-bite prior to the onset. Further, the evidence from Kumaun is so slender and vague that it can hardly be relied upon as an indirect support. Such support to have any validity or value would have to offer something more concrete before inference is justified; while this is true it must be admitted that topographically the *mise en scène* for a tick-borne typhus analogous if not identical with that of the Bitterroot Valley in the Foothills of the Rockies presented itself in the Bhim Tal Valley. To anyone acquainted with the

former infection the analogy must have seemed irresistible. But, however attractive it may have been it has no local epidemiological evidence to support it and the evidence from other parts of India in its support is so meagre as to be negligible. McKechnie himself considered the possibility of such an analogy in his differential diagnosis and rejected it—presumably for the same reasons as it is rejected by the present investigation—e.g., there was no evidence to warrant its assumption. None of his cases, and he saw far more of them than any other observer since, had any history of a tick-bite or any evidence to suggest this occurred. Bearing in mind, however, the epidemiological picture as he saw it, he was careful to consider the louse as a potential vector—presumably because his experience of the hill people and the nature of the fever suggested that such a vector was probable. It should be noted that this was the point of his divergence with Megaw, the latter having only his own case and the topographical analogy to support his disagreement.

It must therefore be agreed that the evidence in support of Megaw's theory depends almost entirely on a topographical analogy which, however attractive, has not the support of immediate local experience, or from outside the Kumaun.

#### V.—HAS MEGAW'S PRIMA FACIE CASE AGAINST THE TICK SUPPORT OF THE EXPERIMENTAL METHOD?

The nature of the investigation carried out in these studies on the possibility of tick transmission and the results have been detailed. It is with certain reluctance that one attempts to form a conclusion based on so limited an investigation, more particularly when the evidence is such as to discredit the views of so distinguished an observer as Megaw. The investigation, however limited, was nevertheless carried out in what might be described as "Megaw's own country" and from which our concept of aberrant types of typhus infections in India arose. Further, it was carried out during the period of alleged seasonal incidence, and the technique employed was such as to afford an optimum trial of the tick theory. It remains to be stated that the results of that trial have been uniformly negative and within the limitations of these studies, may be said to be definitely against the tick theory; in this they are in complete harmony with the epidemiological evidence which has accrued during the ensuing twenty-three years. It is not certain that the trial can be regarded as finally excluding the theory, but it at least suggests that if the virus is to be found in ticks, the species involved must be most uncommon, or that the percentage infected of the species involved is extremely small. Other species of ticks may be involved and the evidence (Parker, Philip, Wellison, 1933) from America has suggested more than one species may be the vectors of the fever; this may also be true in India. In this connexion it is of interest to mention in passing a study in the possibility of tick transmission carried out by the author in 1934. In this investigation an attempt was made

firstly by feeding experiments on human cases of Indian fever to infect the vector of Rocky Mountain spotted fever—the wood tick *Dermacentor andersoni* Stiles; secondly by feeding experiments on guinea-pigs infected with the virus of the American fever to infect the supposed possible vectors of our Indian fevers, *R. sanguineus* and *Hyalomma ægyptium*, with the American virus. The American ticks necessary were very kindly supplied by Parker of the Rocky Mountain Spotted Fever Laboratory, Montana, U.S.A. As a result of these experiments it was found quite impossible to infect the American tick with the Indian virus or the Indian ticks with the American virus. Further, in a more recent study (1930) the details of which will appear in a subsequent paper, it was found quite impossible to infect *R. sanguineus* and *Hyalomma ægyptium* with the Indian virus. It would thus appear they are not even potential vectors of one virus. While this is so it must be admitted that a very much larger investigation would have to be carried out before tick transmission could be definitely eliminated. Bearing in mind, however, the results mentioned above, and those of the present investigation, such a study is hardly justified until the *prima facie* case against the louse is more fully investigated.

It must be agreed then that the *prima facie* case against the tick has not the support to date of the experimental method.

#### VI.—WHAT IS THE EVIDENCE AGAINST THE *PRIMA FACIE* CASE FOR THE LOUSE?

The only evidence (other than the topographical analogy) against the lice theory is the fact that the European incidence of typhus has not been associated with louse infestation or the presence of lice. This objection which caused McKechnie's dilemma is more imaginary than real. It is obvious that only in most exceptional circumstances could he have hoped to find the lice on his European cases. This by no means precludes the possibility that they were not in fact bitten by one or more lice picked up from the natives. An incubation period of fourteen days is the general rule with typhus infection. One must accept, then, that from the date of being infected by a louse an incubation period must intervene. Is it reasonable to expect to find lice on the patient after two weeks from the date of infection? Obviously it is not, and would run in complete opposition with our knowledge of the habits of Europeans in the tropics. One would have to assume that the European's standards of hygiene were a myth, and there is no evidence to warrant this assumption. Indeed, there is everything to suggest that the class of patient involved had at least one bath and a change of clothing per day. One could hardly expect to find them louse-infested or harbouring lice after fourteen days from the date of infection.

It is known, however, that all were in close proximity to louse-infested natives in the typhus endemic area.

One must agree, therefore, that the evidence against the *prima facie*

case for the louse is more imaginary than real, and does not justify the abandonment of the louse theory of infection.

VII.—IS THERE ANY EVIDENCE TO JUSTIFY THE ASSUMPTION THAT TYPHUS OTHER THAN LOUSE-BORNE IS TO BE FOUND IN THE BHIM TAL AREA ?

In view of the modern concept of typhus infections, it is natural to wonder if more than one type is present in the Bhim Tal Valley and the Kumaun. Analogy suggests this possibility, and while time may prove the analogy to be founded on fact, nevertheless it is equally true that beyond analogy there is no evidence on which to establish a *prima facie* case against any other insect. Serology may suggest that there are different types of the virus, but it cannot be taken that this infers a different vector ; it has failed to differentiate the flea-borne from the louse-borne infections, or for that matter to indicate in any way the fundamental differences in these viruses. True, the "humanized" virus is probably an offshoot from the older murine ; it has been proved to be essentially different. Serology here indicates in no way this fundamental change, or the fact that different vectors are concerned. Our knowledge of the Wilson Weil-Felix test is after all very new ; its full significance or relation with typhus infections is unknown. It would seem more cautious and more advisable to accept that this line of investigation indicates no more than that one is probably dealing with a typhus infection, always provided the serological results confirm the clinical diagnosis.

If time proves other vectors to be involved, it is not unlikely that they may be found in the flea and the bed-bug, as suggested by McKechnie. In support of the flea there is the recent work of Covell in the Simla Hills, which however remains to be confirmed by future observers. The immediate findings cannot be ignored and are very suggestive that the flea-borne typhus may exist in the Kumaun Hills, as it would appear to exist in the Simla Hills. It should be remembered, however, that whereas the rat flea *X. cheopis* has been incriminated by Covell, *X. astia*, as in the Madras district, is the common rat flea of the Kumaun (Mackie, 1927), which is, no doubt, one of the factors accountable for the very low plague incidence there.

As regards the bed-bug, there appears to have been a certain association between it and some of the more recent cases from Ranikhet. The potentialities of the bed-bug in the possible dissemination of other diseases is, of course, well known.

While it is possible that flea-borne or bug-borne typhus may exist in the Kumaun, the evidence is not sufficient to justify a case for either of them, and there are certainly no grounds for the abandonment of the case against the louse. It may, indeed, be found that other types of typhus co-exist with the louse-borne, and if this is true the evidence from other parts of the world and from India suggests that the associate is a flea-borne disease.

Whatever may be said for the possibility of a murine typhus in the Kumaun there is nothing to favour a tick-borne disease. The analogy is undoubtedly alluring but when stripped of its topographical brilliance it is found to be rather an empty and disappointing illusion.

To sum up, while it is possible that a murine typhus may co-exist with the humanized typhus in the Kumaun there is as yet not sufficient evidence to justify such an assumption. It seems to the writer illogical to postulate the existence of another type of virus or vector until the strong *prima facie* case of the louse is more fully investigated.

#### VIII.—IS THERE ANY EXPLANATION TO ACCOUNT FOR THE LOW INCIDENCE OF TYPHUS IN NAINI TAL.

Any one familiar with Naini Tal and Bhim Tal will appreciate that the conditions of life in these stations are wholly different. Firstly, Naini Tal is a clean fashionable up-to-date hill station, with a resident population who live in modern up-to-date hotels or in clean private bungalows. Exposure to a louse-infested native population is reduced to a minimum. Indeed there is little contact with the hill people—contact is confined to shopowners from the plains, and one's servants; the only immediate contact for the residents is with his dandy coolies, but for hygienic reasons these are given clean uniform. Further, Naini Tal lies above and outside the main hill route and as such is not exposed to the introduction of disease.

In Bhim Tal, however, conditions are very different. First, it is definitely more of a hinterland; indeed, it is no more than a native hill village. Secondly, the European population consists mainly of people on fishing or shooting expeditions where the conditions of life necessitate close contact with the natives, and more or less "roughing it"; life is altogether on a simpler plain and not protected against disease in the same organized manner as in Naini Tal.

It is just the difference between a modern organized community and a comparative backwood in the hills. Further, Bhim Tal lies on the main hill road.

Naini Tal is therefore not so exposed to these infections because it is more civilized and the native hill life forms in it only an imperceptible background.

#### IX.—WHAT IS THE PRESENT DAY POSITION IN THE BHIM TAL AREA?

The two most notable features of the present-day incidence of these fevers in the area is the complete absence of any such infections in the Jind and Sat Tal Estates. It is noteworthy, however, that the Maharaja and his staff when on trek provide their own tentage and do not use the various Dak or Inspection bungalows. It is also notable that despite the fact that they are frequently bitten by ticks while on trek, there has been

no incidence of these fevers among them. As regards the Sat Tal Ashram it is difficult to account for the absence of these fevers, except that little, if any, mission work is done there, the college merely affording a holiday resort for missionaries from the plains for a short period. Despite this, however, one would have expected the disease to have manifested itself some time during the past six years.

The evidence taken as a whole suggests that while there can be little doubt that the area is subject to the introduction of typhus and minor epidemics, and is probably an endemic area : at the moment it is passing through a refractory phase which is a characteristic of other endemic areas throughout the world. The factors responsible for these vagaries in disease incidence are of course unknown. They belong to the realms of experimental epidemiology, and are probably associated with as yet unknown characters in the life cycle of the virus and its vector, together with the possible reduction in the area for a period of the number of susceptibles, and also with factors which govern the recrudescence of the disease in human reservoirs. These, and possibly other unknown factors, are at work in the creation of the present day epidemiological picture, the explanation of which will follow in the wake of experimental epidemiology.

#### CONCLUSIONS.

(1) Typhus is endemic in the Kumaun Hills. The geographical position of the Bhim Tal Valley renders it especially prone to minor epidemics and a relatively high inter-epidemic rate incidence.

(2) The local epidemiological factors suggest that the virus is of the "humanized" louse-borne type.

(3) The co-existence of a "murine" flea-borne virus is suggested by analogy. If this is so, it may account for some of the inter-epidemic cases and the dissemination of the "murine" virus in epidemic proportions through the agency of lice.

(4) The existence of a tick-borne virus in the Kumaun Hills is unsupported by epidemiological evidence or by the experimental method.

In conclusion I take this opportunity to express my gratitude to Major-General E. A. Walker, C.B., M.B., F.R.C.S. Edin., I.M.S. (late D.M.S., India) for the financial support he has given to these studies ; to Colonel J. A. Manifold, D.S.O., V.H.S., M.B. (Dy. Dir. Hygiene and Pathology, India) for unfailing patience, encouragement and support ; to Colonel J. Taylor, D.S.O., M.D., I.M.S. (Dir. C.R.I., Kasauli), for the supply of animals and the facilities of the C.R.I. Library ; to Lieutenant-Colonel G. Covell, M.D., D.P.H., I.M.S. (Offg. Dir. Malaria Survey of India) for much help and advice ; and lastly, but not least, to my two "Lab Boys," Abdul Majid and Hira Lall, without whose help there would be so little to record. To all these, and many others, I am indebted and without their help these studies could never have been undertaken.

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## Editorial.

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### THE HEALTH OF THE ARMY.

IN his report to the Under-Secretary of State, War Office, Lieutenant-General Sir James Hartigan states that although the general health of the Army throughout the year 1936 continued to be very satisfactory, the statistics show an all-round increase over those for 1935. They are also higher than for the quinquennial period 1931-35.

The admission rate, which showed an increase of 35·6 per 1,000 over that for 1935, was higher in all commands except at home, Malta and Gibraltar, in which commands it was slightly lower. The commands with the largest increase were Egypt, Palestine and China. In Egypt and Palestine the diseases responsible for the increase were sand-fly fever, diseases of the skin, inflammation of the tonsils and diseases of the digestive system. In China, influenza, venereal disease and malaria accounted for 80 per cent of the increase.

The principal causes of admission to hospital were inflammation of areolar tissue, venereal diseases and malaria.

Judged by the average sick time to each soldier, the commands with the highest ratio of inefficiency were: China, Aden, Ceylon and Jamaica.

The principal causes of invaliding were tuberculosis, inflammation of the middle ear, and effects of old injury. The average sick time to each soldier was 8·50 days, compared with 7·93 in 1935 and 8·06 for the period 1931-35; 208,419 soldiers were treated as out-patients, with an average daily number under treatment of 2,998·54. The combined ratio of constantly sick in hospital and under treatment as out-patients was 39·59 per 1,000 of strength, compared with 37·16 in 1935 and 37·69 for the period 1931-35.

In Table III the effects of common ailments on military efficiency in commands at home are shown. Local injuries caused a loss of 90,014 working days; diseases of the digestive system, 49,685 days; and venereal diseases, 45,629 days. In commands abroad, shown in Table IV, venereal diseases rank highest and caused a loss of 108,918 days; then come local injuries with 45,303 days; diseases of the digestive system with 39,268 days; and tonsillitis with 15,105 days.

The notes on diseases contain much of interest. The enteric group of diseases, which in the 'nineties caused so much sickness, are now of less import, and this is especially notable when troops are serving abroad under Service conditions. In both the Western Desert of Egypt and in Palestine the number of admissions for this group totalled only 96, as compared

with 129 in 1935. The admissions were classified as : Typhoid fever 22 ; paratyphoid A 14 ; paratyphoid B 5 ; paratyphoid C 1 ; enteric group 54.

Only 3 cases of typhoid fever occurred in Egypt, 2 in Palestine and 2 in Khartoum. In India the admission rate is the lowest ever recorded, and a striking feature is the fall in the number of admissions amongst Indian troops.

It is thought that some of the reduction among enteric group cases may be due to the increasing recognition of mild typhus cases, but this would not apply to the reduction of both typhoid and paratyphoid A groups in Indians, as the incidence of the typhus cases among them was identical with that of 1934. The deaths from enteric fever among British and Indian troops have been greatly reduced. There has been no corresponding decrease among the civil population, but rather an increase, and though there has been strict attention to hygiene there has been no dramatic change in the general hygiene of military areas. There has been increasing interest in child welfare taken by Indian units, and unsuspected cases of the enteric group have been brought to light and properly treated. In this way foci of infection may have been eliminated. The main factor, however, seems to be the supply of T.A.B. vaccine prepared from strains of exalted virulence at the Royal Army Medical College ; this has taken place recently following on researches carried out at the College with various strains of typhoid and paratyphoid bacilli.

The protective value of the recently modified vaccine is illustrated by the returns from Egypt and Palestine already noted. The strength of the troops was doubled, but there was no increase of typhoid fever ; the case rate was only 0·4 per 1,000, compared with 1·7 in 1931. The year 1936 was considered a bad year for civilians.

The period at which infection occurred after inoculation is of considerable interest, and may have some relation to the virulence of the vaccine employed. There has been very little change in the percentages of the whole enteric group cases after six months, six to twelve months, and twelve to eighteen months ; but in the bacteriologically proven typhoid cases there has been a big drop in the percentage of cases occurring in the first six months after inoculation and a distinct rise in the twelve to eighteen months' period.

There were 1,797 admissions for dysentery, classified as bacillary 1,309, amœbic 193, and clinical 295 ; these were 74 more than in 1935. In Egypt and Palestine there was an increase of 260 admissions, which was probably due to an increased number of troops serving under active service conditions. There were two waves in the incidence in Egypt—one in April and one in November—which were associated with periods of greatest fly incidence. The dysentery reported at home was always a recurrence of an infection contracted abroad.

In India the greatest incidence corresponded with the fly season, and in the Northern Command it was noticed that units which had recently

arrived at their stations after a train journey produced a small crop of cases. In peace conditions there is no doubt that dysentery is largely due to the insanitary conditions prevailing in the civil community. The absence of any reliable method of conferring immunity against the numerous varieties of dysentery bacilli and the range of fly infection are the main causes why the prevalence in India in 1936 is still as high as 42.1 per 1,000, while the enteric group of diseases is responsible for only 1.5 per 1,000. The distribution of the groups, protozoal, bacillary and clinical, in commands does not show much difference, and the percentage of the various types in Indian troops is very similar to that of British troops.

The various types of dysentery bacilli isolated from cases have not changed much in the past four years. The strains described by Boyd are now recognized in the laboratories, and his scheme for the identification of bacillary groups has come into general use; "inagglutinable Flexner bacilli" have practically ceased to exist.

Much work has been done by Army medical officers on the group of typhus fevers, and several papers on the subject have been published in this Journal.

There were 44 cases of the typhus group of fevers, 9 reported among British troops in India, and 2 cases of Japanese river-fever from Malaya. Three of the Indian and 1 of the Malaya cases died. In addition, 47 cases were diagnosed among Indian other ranks, but owing to the difficulty of differential diagnosis of certain of the mild cases, without any trace of rash, the figures may be understated.

The cases were placed in three groups according to their agglutination reactions. The classifications of all cases (including other than British and Indian) were: OXK—British 29, Indian 9; OX19—British 9, Indian 32; OX2—British 9, Indian 7; unclassified—British 6, Indian 7.

The OXK group mainly occurred in the autumn months; the OX19 were evenly distributed throughout the year.

In inoculated men suffering from typhoid or typhus fever co-agglutination is still a source of difficulty, and records of tests are being collected for analysis at a later date with a view to clarification of the question.

It is considered at the present time that no definite conclusions regarding the natural reservoir or the carriage of infection to human beings in the Indian series can be formed. It is felt that in the present state of our knowledge remarks on seasonal incidence, distribution in commands, and vagaries of agglutination reaction found in the sera of T.A.B. inoculated patients suffering from the typhoid group and typhus fevers, should not be regarded as significant until a larger number of records have been compiled and analysed.

It was anticipated that 1936 would be a bad year for malaria in India, but this did not prove to be the case, and with the exception of the Northern Command and Burma there was a general decrease.

The increase of malaria in the Northern Command was an aftermath

of the Mohmand operations in 1935. During the operations quinine was given to delay the outbreak of infection, and while this resulted in men being able to keep at work for a considerable time, there were many relapse cases and latent infection cases during the following spring.

Multan is now the most malarious station, having an admission ratio of 176·0 per 1,000. The reason for this is the change in climatic conditions. Increased humidity and rainfall have become apparent in the areas affected by the new irrigation from the River Indus. The increased incidence of malaria in Hyderabad is attributed to the same causes. In Quetta and Landikotal the increase was due to the delayed action resulting from the quinine given in the Mohmand operations. Malaria has been reduced in Delhi, due in part to intensive anti-malaria measures in both civil and military areas in the city. Benign tertian is the most common variety of malaria. All three varieties occur in the Southern Command, this being the only command in which quartan malaria exists to any extent.

Routine treatment has been by (1) atebirin—0·3 gramme daily for seven days, followed after an interval of three days by plasmoquine—0·03 gramme for five days (in some hospitals quinine is given for the first forty-eight hours after admission and before the administration of atebirin); or (2) quinine 20 grains, with plasmoquine 0·03 gramme daily for twenty-one days.

The relapse rate for all India was about half that of 1932, viz. 18·7 per 1,000 compared with 34·9 per 1,000. In the Southern Command the relapse rate has fallen to 9·0 per 1,000, and in the Eastern Command to 6·3 per 1,000. In the Northern Command the relapse rate increased from 13·2 to 32·8 per 1,000; this increase was probably due to the Mohmand operations, when "delay action" quinine was given and the treatment of cases which occurred was interrupted by the necessity for evacuation over a distance of 200 miles from the forward areas.

In Egypt there was an increase in the number of primary cases of malaria which occurred principally in the Sudan and mainly among young soldiers who had lately arrived from the United Kingdom. The incidence of malaria depends on the rise and fall of the Blue Nile, which leaves stagnant pools forming excellent breeding places.

There was an increase in the incidence of malaria in Shanghai which coincided with a large increase among civilians.

It is generally reported that atebirin is not as efficient as quinine in reducing the fever in malaria and that it is much slower in its action. A study of temperature charts in Egypt revealed cases having rigors after the atebirin treatment had commenced.

In the Notes on Special Departments it is stated that the system of grading the more junior officers as physicians is proving very satisfactory from every point of view.

The cardiac centres established in London, Aldershot and Catterick have proved to be of great service in the diagnosis of cardiac disorders, especially in youthful cardiac irregularities, in the prognosis of extra systoles in middle age, and in cases of coronary disease.

Comment is made on the work on the typhus group of fevers by Army medical officers. Four cases of tick-borne disease in Palestine by a young officer graded as a physician have been published in our Journal. These and other papers show the wealth of clinical material available to Army medical officers both at home and abroad.

It is stated that sodium mandelate with ammonium chloride has proved very successful in the treatment of *B. coli* infections.

In Malaya two cases of cutaneous Leishmaniasis were treated by injections of anthromaline (lithium antimony thiomalate) with success.

During the year 10,975 operative procedures were undertaken in hospitals at home and abroad (except India). The mortality was only 0·6 per cent. In India 3,600 operations were performed. There has been little change in the operative arrangements at the various hospitals during the year. Surgical, ear, throat and nose, and eye specialists have commented on the revised scale of equipment which is considered to be up to date and satisfactory for modern requirements.

The sanitary organization and practice throughout the Army was tested by two small emergency forces sent to Egypt and Palestine. It is satisfactory to note that the total admissions to hospital were only increased by some 30 per cent, and these were due to diseases of the areolar tissue and skin, dysentery and diarrhoea, malaria and sandfly fever. The troops in Palestine were operating mainly in small detachments and during the season of biting insects and suffered somewhat severely in spite of the use of quinine and repellant oils. The units in the Western Desert in Egypt were infected with a plague of flies bred in local Bedouin camps, with a consequent sudden increase in the incidence of dysentery and diarrhoea for a short period between detection and removal of the nuisance.

The accommodation in barracks is being much improved and the new Sandhurst block provides sleeping rooms, sitting rooms, dining room and the whole of the sanitary and bathing accommodation for single rank and file under one roof. Hot water is provided for baths. The block is centrally heated and there are open fires in the sitting rooms. Single warrant officers and serjeants' bunks are in the Serjeants' Mess or in a small block adjacent to it.

After the Great War it was recognized that the soldier should be fed completely by the State and a ration was eventually devised based on the requirements of one hundred men in mess for seven days and providing 3,600 calories per man per day.

Criticism was made that the ration did not provide for an evening meal

after tea ; that it was not sufficient for small units, and as there was no limit to the number of military families eligible to draw rations in kind, the meat ration issued to the men's messes suffered correspondingly. In 1935 a War Office Committee recommended : (1) A cash allowance to cover the cost of a supper ; (2) an increased issue for those who are entitled to draw rations on an individual basis and not messed collectively ; (3) that soldiers on the married role should be included among those to be fed on an individual basis.

In the Hygiene Section there are further interesting notes on water supplies, swimming baths, anti-malaria measures, and mother and child welfare.

At the Royal Army Medical College a welcome innovation has been the attendance of officers from the Staff College. Junior officers of the School of Engineering, Chatham, attend the College ; this practice was instituted seven years ago and gives an opportunity for the exchange of views.

A lecture on man management is now included in the syllabus of lectures at the Senior Officers' School, Sheerness.

A new lorry disinfecter has been designed ; it will be carried on a thirty-hundredweight lorry and will replace the mobile Thresh disinfecter.

Experiments on water purification in the field are being continued with the object of settling points raised in connexion with super-chlorination followed by dechlorination.

In the Department of Pathology at the College important research work has been carried out on immunization against tetanus and we published in our last number a paper by Major J. S. K. Boyd on this subject also papers on the laboratory control of typhus prophylaxis by A. T. Glenny and M. F. Stevens, and the preparation of formol toxoid and alum precipitated toxoid by J. G. C. Campbell from the Wellcome Physiological Research Laboratories. It seems possible now to combine inoculation of T.A.B. vaccine and tetanus toxoid.

The situation in Egypt and Palestine afforded an opportunity for testing the recently modified T.A.B. vaccine and it is gratifying to note that though the strength of the troops was doubled the case-rate for enteric fever was only 0·4 per 1,000 compared with 1·7 per 1,000 in 1931. On the other hand there was an increase of enteric group infections among civilians. In both Egypt and Palestine the typhoid organism appeared to be a highly virulent strain and infection tended to be severe. It would seem, therefore, that the incidence on the troops was favourably affected by the introduction of the new vaccine.

Co-operation with the Medical Research Council workers on influenza has been continued and an important trial with the new mouse vaccine was begun at the end of the year. The results of the first trials with the mouse vaccine were not very convincing. It would appear that the virus of the 1933 epidemic used in the first trial differed from that obtained in the 1936-37 epidemic, and in future it will be necessary to choose an inoculum

made from a virus belonging to the same immunological group as that responsible for the immediate outbreak.

In consequence of the falling off in the number of recruits during recent years, a War Office Committee was assembled in May, 1936, with the object of finding out whether the present physical standards should be modified, and whether it would be possible to take into the Army recruits below the standards decided on, but who might reach these after special training. The Committee agreed that the standards of general health and physique should not be modified, but the increase of mechanization and the increase of specialization would permit an adaptation of standards to conform with these conditions. Accordingly the Army was divided into four classes: (a) Horse and foot class; (b) mechanized class; (c) M.T. class; (d) L. of C. class. A medical committee drew up standards for these classes.

A preliminary experiment was carried out at the Army School of Physical Training, Aldershot, on men below standards of weight and chest measurement, and on those with functional defects of the heart. The results were so satisfactory that it was decided to establish a special centre for the "reconditioning" of recruits of this type. It was also decided to admit to this centre "border-line" recruits, viz. those suffering from defects of such a degree that the examining medical officer cannot decide as to their fitness without further observation. Finally, it was decided to enlist and admit to hospital recruits fit in every way except for a curable defect such as varicose veins or enlarged tonsils.

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## Clinical and other Notes.

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### A CASE OF COMPLETE BILATERAL DISLOCATION OF THE NECK.

BY CAPTAIN R. A. STEPHEN,

*Royal Army Medical Corps.*

THE rapid growth of motor traffic during the last decade has led to frequent accidents in civil life. Quite a large proportion of these accidents result in spinal injuries which are not very frequently seen in military hospitals during peace time.

The commonest lesions are crush fractures and partial dislocations with or without injury to the spinal cord. The former are caused by direct or indirect violence. Indirect violence acts through acute flexion of the spinal column whereby one or more of the vertebral bodies are crushed. If the force is continued it results in a fracture or dislocation of the adjacent articular processes on one or both sides of the crushed vertebra which allows the upper vertebra to slip forward on the lower. Dislocations are more common in the cervical region as the articular processes there are much nearer the horizontal plane than elsewhere in the spinal column. Most frequently the injury occurs at the points of greatest mobility in the spinal column, namely the 4th, 5th and 6th cervical segments and the 12th thoracic and 1st lumbar.

Damage to the cord occurs due to displacement or compression of the vertebræ or to excessive flexion.

Loss of function is due to actual injury of the nerve cells in the cord or nerve roots at the time of the accident or to subsequent central hæmorrhage, anæmia or traumatic œdema. Much of the damage may be due to rupture of the nerve fibrils, the actual axons or their myelin sheaths.

Spinal shock accompanies the severe injuries, and is due to anatomical and physiological derangement in varying proportions. As a result of the physiological derangement immediate loss of reflex activity in the cord distal to the site of injury does not necessarily mean irrevocable damage to the cell structures. As the primary cell stations are outside the cord, sensory changes are more reliable than the extent of the paralysis in separating the two types of derangement.

Prognosis should be good in patients with immediate virtual quadriplegia, but not complete anæsthesia, when there is some recovery within twenty-four hours.



## TREATMENT.

(1) Lumbo-dorsal region. Watson Jones' method of applying a plaster of Paris splint with the spine in the position of hyperextension is very satisfactory.

(2) Lower cervical region. The dislocation may be reduced under a general anæsthetic or by slow traction. The patient is then immobilized in a plaster of Paris splint in the position of hyperextension.

The case about to be described presented the following points of interest :—

The site of the dislocation was between the 5th and 6th cervical vertebræ. The amount of displacement as shown in the lateral X-ray film was so great that compression of the spinal cord seemed inevitable. The size of the spinal canal at that site saved the cord from permanent injury. Fortunately neither inflammatory changes nor hæmatomyelia supervened.

Antero-posterior and lateral X-ray views were taken of the injured area following the reduction of the displacement. These showed the articular and spinous processes to be in perfect alignment. No evidence of fracture of the body of the 6th cervical vertebra appeared, such as a fracture line, a localized increase of density in any part of the bone or convergence of the adjacent surfaces of the 5th and 7th vertebræ. Fortunately a normal film of the patient's neck, taken before the accident, was available. When the shadows of the body of the 6th cervical vertebra in the two films were compared and measured they were found to be exactly the same size. Yet, after reduction of the dislocation, the 6th vertebra was still displaced backwards for about a quarter of an inch. These findings point definitely to a fracture of the pedicles of the 6th vertebra. Such a fracture is not mentioned in the textbooks I have been able to consult.

Injury to nerves : No loss of sensation showed that the 6th pair of posterior nerve roots had escaped injury. Permanent (only six months after injury) damage to nerve tissue was limited to a few fascicles of the anterior nerve roots of 6th pair of cervical nerves.

Complications : Prontosil given intramuscularly had a dramatic effect on the hypostatic pneumonia.

## DIFFICULTIES ENCOUNTERED IN THE TREATMENT OF THE CASE.

With the type of X-ray plant at our disposal it was impossible to use the Potter-Bucky diaphragm for any of the films. Lack of stereoscopic films made detailed diagnosis of the bony lesion difficult. The absence of an orthopædic table added to the difficulties of treatment.

Textbooks give very little assistance as to how the case should be nursed, dismissing the subject in a few sentences. A bald statement such as "The sooner a plaster jacket is applied the better" is easier said than done.

No satisfactory method of fixation was devised. The patient's condition was so critical after reduction of the dislocation that nothing more could be attempted at that time. We found that sandbags and a rubber air-bag under his neck controlled the position most satisfactorily, but threw a great strain on the nursing staff consisting entirely of R.A.M.C. orderlies.

After the first few days it became necessary to devise a more stable form of support for his neck. Without the proper equipment direct plaster fixation was impossible, so that the improvised indirect method described below, though far from perfect, had to serve the purpose. A close-fitting plaster of Paris collar was impracticable as it interfered with feeding and movements of the jaw. On account of the marked muscle wasting it would soon have become loose. Frequent vomiting and excessive sweating would have fouled the plaster.

The onset of pneumonia prevented any further experiments on fixation as the patient was practically moribund.

The metal support which was used after he recovered from the pneumonia proved very satisfactory. Unfortunately this could not be used at an earlier date because of risk involved in fitting it on.

A light adjustable spinal splint which can be fitted accurately within the first few hours is sorely needed for the treatment of injuries to the cervical spine. With such a splint in use the patient could be nursed in an upright position and so diminish the risk of pulmonary complications.

Private M., R.A.M.C., a powerfully built, short-necked soldier weighing about 190 pounds, was playing Rugby football on February 28, 1937, when he was involved in a scrummage which collapsed. Falling forwards with his neck acutely flexed (indirect violence) he struck his vertex on the ground as the rest of the scrum fell on top of him. He felt and heard something crack in his neck. On attempting to rise, he could not move but retained consciousness and distinctly remembered that his limbs felt numb. It appeared that he was suffering from spinal concussion as the functions of the spinal cord below the site of injury were temporarily suspended. Fortunately, medical attention was available on the field and his removal to hospital was carried out under supervision.

One hour after admission he was still suffering from a severe degree of shock, but the effects of spinal concussion were passing off. He had no headache, but complained of a dull pain in his neck and a feeling of "pins and needles" in all his fingers.

*Sensation.*—There was no loss of sensation anywhere on the body surface, as tested with cotton wool and a pin, but some impairment was detected all over his right hand.

*Muscle Power.*—There was general weakness all over the body distal to the site of injury. The right side was more seriously affected than the left, especially the arm, where the triceps brachii and the extensor muscles of the wrist and fingers were completely paralysed.

*Reflexes.*—The tendon reflexes were elicited without difficulty but the responses were poor. The abdominal and cremasteric reflexes were present. The right plantar reflex was an extensor reaction, whilst that on the left could not be elicited.

*Respiration.*—His respiration rate was eighteen per minute. Palpation of the cervical spine revealed some swelling just above the vertebra prominens.

*Treatment.*—He was placed on a bed covered with three hair mattresses supported by fracture boards. A poroplastic splint was fashioned to support his neck while his head was kept in a fixed position by means of sandbags. He was treated for shock.

March 1, 1937: His general condition had improved but local changes had appeared. His sensation was still unaltered but there was marked paresis (almost amounting to a hemiplegia) in his right upper and lower limbs.

*Reflexes.*—Both knee-jerks were elicited with difficulty, but all skin reflexes were absent.

*X-ray Findings.*—Lateral view: There was a complete bilateral dislocation of the cervical vertebræ between the 5th and 6th. The body of the 5th was displaced half an inch forward in relation to the body of the 6th. The normal cervical curves above and below the site of injury were intact. The tips of the upper articular processes of the 6th vertebra lay immediately behind the tips of the lower articular processes of the 5th. The intervertebral disc appeared to have been carried back along with the 6th vertebra. Antero-posterior view: The film appeared normal except that the vertebræ above the 6th were tilted slightly to the right.

The dislocation was reduced under a general anæsthetic by strong traction and lateral manipulation with slight extension. The reduction was confirmed by X-ray. The antero-posterior film appeared normal, but the lateral one showed the body of the 6th cervical vertebra still about a quarter of an inch behind the line of the others although the spinous and articular processes were in perfect alignment. In spite of that, no signs of fracture of the body of the 6th were seen, such as a fracture line, a localized increase of density of any part, or convergence of adjacent surfaces of 5th and 7th vertebræ. This suggested a fracture of the pedicles of the 6th cervical vertebra. There was marked mobility at the site of the injury.

Following the reduction of the dislocation the patient's condition was very critical. The pulse-rate and respiration rate became very slow and caused anxiety. After about ten minutes they were restored to normal. No Q.A.I.M.N.S. Nurses are stationed here, so the nursing was carried out entirely by R.A.M.C. Orderlies.

He was placed on a hair mattress made in three sections, with supporting fracture boards underneath. His shoulders had to be raised off the bed by means of a sling between two Balkan Beams so that the necessary degree

of extension of his neck could be maintained. His head with the vertex resting on the mattress was kept steady by sandbags, while a rubber air bag under his neck maintained the hyperextension and added greatly to the patient's comfort. As a prophylactic measure, light splints were applied to the right forearm to counteract the tendency to wrist-drop.

He required catheterization.

March 2: His general condition had improved. His temperature, pulse-rate and respiration rate were normal. He still required catheterization and an enema. He could take semi-solid food but had great difficulty in swallowing.

*Sensation.*—No areas of anæsthesia were present.

*Muscle Power.*—On the left side of the body he had regained all the movements of his limbs and the contractions were fairly powerful. A definite contraction was noted in the extensor muscles in the right arm and forearm.

The neurological examination was extremely difficult as the patient became tired easily and could concentrate only for brief intervals.

March 3: Urine was voided voluntarily.

*Sensation.*—Still unimpaired. The skin reflexes were normal except that the right plantar reflex was extensor.

*Muscle Power.*—No change was noted.

He developed a very acute follicular tonsillitis with much œdema of the anterior pillars of his fauces. There was an excessive secretion of saliva which he was unable to swallow.

Glucose salines were administered per rectum.

March 4.—*Muscle Power:* There was marked paresis in both upper limbs. He was unable to touch his face, but definite paralysis was present only in the left biceps brachii and in the extensor muscles in the right arm and forearm.

March 8: The acute tonsillitis had practically subsided.

The patient was lifted into a plaster of Paris cast which had been modelled on a soldier of similar build.

The cast extended from his brow, over the vertex, behind the occiput and hyperextended neck, and down to the 12th dorsal vertebra. As far as possible it covered the side of his head, neck, shoulders and thorax. There was no constriction of the thorax.

Gentle general massage with passive movements of joints was started.

March 12: The plaster cast added greatly to the comfort of the patient and the nursing difficulties were simplified.

The position of hyperextension was maintained without difficulty. His general condition improved, but he lost weight. The lower limbs improved tremendously. The movements were full but the muscular contractions were not as powerful as before his accident. Both limbs were about the same. The muscle power had returned in both arms except in the left biceps, coraco-brachialis, brachialis anticus and deltoid, and in

the right triceps and extensor muscles of the wrist. These muscles, however, still responded to a strong faradic current.

March 14: Another X-ray showed a slight displacement at the site of injury. This was rectified, and in the second set of films a marked swelling of the prevertebral tissue opposite 5th, 6th and 7th cervical vertebræ was noted, chiefly below the cricoid cartilage.

March 20: He developed a basal hypostatic pneumonia. He became torpid and made no effort to move his limbs.

March 25: He was practically moribund. The plaster cast was removed and he was put in a low sitting-up position with a sandbag behind his neck.

March 30: The consolidation of the lungs extended well forward in front of mid-axillary line. He was given large doses of "prontosil" intramuscularly. His limbs were completely paralyzed, but this was largely due to inanition.

April 1: There was unbelievable improvement in his condition. The temperature and pulse-rate and respiration-rate were normal. The patient was bright and quite clear mentally. He lost a tremendous amount of weight and looked like a skeleton. He had incontinence of urine, but bowels were kept open by means of drugs. Both arms were useless as no voluntary contraction could be elicited. His shoulder, elbow and wrist-joint were stiff, due to the presence of adhesions. All the muscles in his right upper limb responded very weakly to faradism. The contractions of the extensors of the wrist were just perceptible. The muscles of the left upper limb gave an even poorer response. No response was elicited in the left upper arm and left deltoid. No paralysis was present in lower limbs.

April 11: A metal spinal support was fitted which extended the whole length of the spine. This maintained full extension of the neck. It had a cushion behind the occiput and an adjustable band around the forehead. It had saddles over the shoulders to support the weight of the head and phlanges under the axillæ and over the iliac crests to prevent lateral movements. A bodice, with lacing up the front of the abdomen, kept the splint in position. With this splint on he could be propped up on a "mutaform" bed. His appetite was returning. Micturition was normal.

April 19: X-ray. The position was unchanged. The anterior edge of the 6th vertebra was still behind the line of the others by about a quarter of an inch. There was a haziness around the posterior part of the intra-vertebral disc between the 5th and 6th vertebræ suggestive of callous formation. The prevertebral shadow was still present, but reduced in size. A mass of callous was present between that shadow and the anterior surfaces of the 5th, 6th and 7th vertebræ. Massage and movements resumed. Adhesions of joints were dense.

May 5: He was able to sit up in bed with the splint on unassisted.

May 12: He was allowed on his feet. He weighed 120 pounds.

July 17: X-ray.—The continuity of the spinal column had been restored

to a remarkable extent by the laying down of a strong bony buttress on the anterior aspect of the 6th cervical vertebræ which supported the column above. The remainder of the film appeared normal.

*General Review.*—He progressed rapidly and appeared restored to normal apart from stiffness in the lower part of his neck and wasting with paresis in the following muscle groups of his upper limbs. All the muscles affected derive the whole or part of their nerve supply from the 6th cervical nerve.

*Left Upper Limb.*—Shoulder girdle: Serratus magnus, supra- and infra-spinatus, subscapularis, and pectoralis major. All these muscles were weak and wasted, but good voluntary contraction was present in them all. Part of the paresis appeared to be due to disuse following the wearing of the spinal support.

*Upper arm:* Deltoid, biceps and outer head of triceps were wasted to a marked degree so that the muscle substance was just palpable. Voluntary contraction was just perceptible.

*Forearm:*—Pronator radii teres and supinator brevis were weak and wasted. The other muscles in the limb deriving their nerve supply from the 6th cervical nerve were unaffected.

*Right Upper Limb.*—Upper arm: Outer head of triceps was weak and wasted.

*Forearm:* Extensor pollicis longus and brevis, extensor communis digitorum and minimi digiti, extensor carpi ulnaris, extensor ossis metacarpi pollicis, supinator longus and brevis and extensor carpi radialis longior were wasted to a marked degree, but voluntary contraction was present. The shoulder, elbow and wrist joints in both limbs were stiff on account of adhesions formed while he was suffering from pneumonia.

August 21: There was still further improvement in muscle power in the above muscle groups. Private M. was brought before a medical board and sent home to England.

My thanks are due to Lieutenant-Colonel S. J. Barry, R.A.M.C., Officer Commanding, British Military Hospital, Tientsin, for his kind permission to forward this paper for publication, and to Dr. Grice, Civilian Surgeon, Tientsin, for his kind and valuable assistance in the above case.

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## HAMILTON CHAIRS.

BY LIEUTENANT-COLONEL T. O. THOMPSON,

*Royal Army Medical Corps.*

THIS simple and ingenious device for easier transport of sitting wounded or sick cases has recently been tried out with success in the Waziristan Operations, 1937, although first introduced into use in Mesopotamia, 1916.

The writer hastens to disclaim entirely any credit or connexion with the original ideas, design or introduction of this device and is acting purely in the role of historian. The device is so simple, practical, inexpensive, and appears so definitely to be a valuable asset in the collection and removal of casualties that it seems a pity that it should not be made known to as wide a circle as possible.

The apparatus was devised by Colonel (now Major-General) W. H. Hamilton to provide more secure carriage of sitting cases when being evacuated by means of the riding ponies or mules which are provided for field ambulances under the War Establishments of India.

The normal equipment of riding ponies for sick, of which there are forty allowed by the full War Establishment, is an ambulance pattern saddle. This is a somewhat heavy special saddle with large leather side flaps provided with knee rolls. Unless the patient is a horseman, sitting on one of these saddles on a steep mountain track is no mean feat for the average infantryman, even at a gentle walk. The writer has many a time seen the patient walk rather than trust himself to a highly-polished ambulance saddle.

The Hamilton chair is intended to provide a more secure seat, a seat on which any patient entirely unaccustomed to riding may feel secure and be adequately supported during his evacuation by pony or mule to the main dressing station or car post.

The device is illustrated in the accompanying photographs. It is in practice not a chair but a ring saddle similar to that used for very young children; the main essential feature is a strong supporting bar in the front to which the patient can cling and over which he can support himself when unable to sit upright.

The device is designed to make use of ordinary standard pattern, universal saddles, and by the addition of four small sockets, four upright posts, a supporting front bar and a circular strap, to convert a proportion of these into saddles suitable for the evacuation of casualties when required.

By this means the ambulance pattern saddle can be replaced by the ordinary standard pattern universal saddle fitted with the modifications necessary to convert each into a ring saddle as and when required.

The modifications consist of four steel sockets let into the frame of the

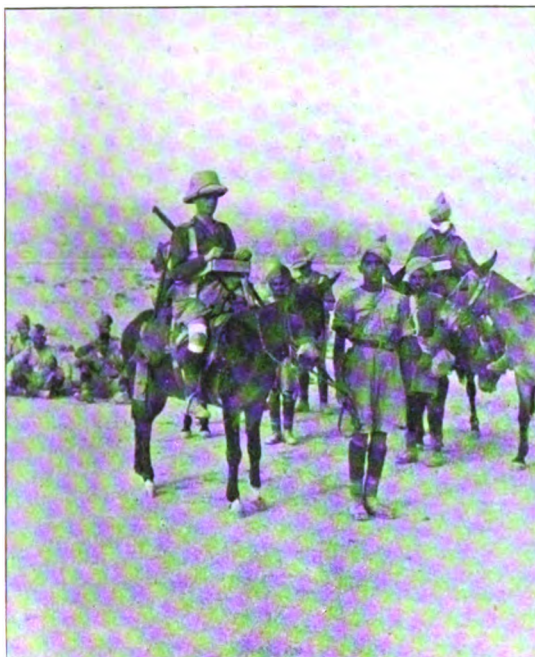


FIG. 1.



FIG. 2.

FIGS. 1 and 2.—Wounded in Waziristan being evacuated in the Hamilton Chair.



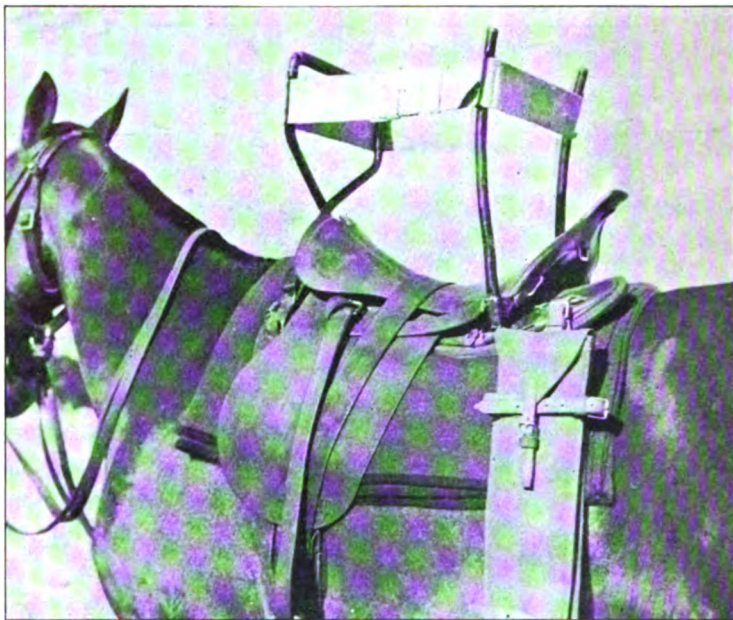


FIG. 3.

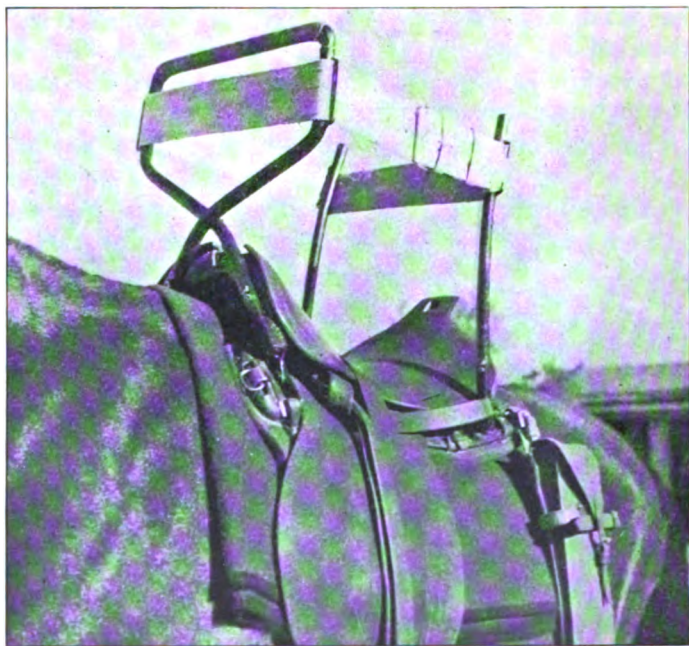


FIG. 4.

FIGS. 3 and 4.—The Hamilton Chair.

universal saddle. Two sockets at the rear of the saddle and two in front. Four steel bars form the supporting pillars. These are shaped at the lower end to secure a tight fit into the sockets, and at the upper end each of them has a slot to take the strap.

The top of the two front pillars is socketed to receive the down-curved ends of the front supporting horizontal bar which fixes into these uprights. These two uprights and bar form a broad flat arch across the front of the saddle.

The strap should be fixed permanently to the front near pillar. This strap is of broad webbing. Being fixed at the left front of the saddle, it can be kept well out of the way when the patient is mounting. It is passed round to the right of the patient, then behind him and fastened off on the left side.

The whole apparatus is carried in a small bag strapped to the saddle, and causes little increase of weight and no inconvenience. The only alteration to the standard pattern universal saddle are the four sockets.

For transport of a patient the front uprights are fixed into their respective sockets and the front supporting bar clipped into position on to the top of these. The strap being kept well out of the way over the neck of the animal, the patient is helped on to the saddle. He can hold on to the supporting bar to help himself into position and to keep himself there.

The two rear pillars are then fixed into their sockets and the strap is passed round the patient through the slots of the pillars and fastened off on the left of the patient. The whole operation of placing in position the uprights, supporting bar and strap, takes only a few seconds to complete.

The man is now in a strong ring saddle which gives him a feeling of security with a firm fixed bar in front of him to which he can cling for support (*vide* fig. 4). The patient usually cannot sit upright, but relaxes his back into a crouching position. The front bar then affords exactly the support which he needs and over which he can slouch forward in a relaxed position.

This pattern saddle was not made available, owing to various causes, until the late stages of the Waziristan operations, 1937, but has been successfully employed in the culminating actions. Favourable comment has been received from patients who were evacuated to the field ambulance by this means. The only adverse comment has been that patients feel very exposed when active sniping is in progress and cannot get down as quickly as they would wish.

I am indebted to Major-General W. H. Hamilton, C.B., C.I.E., C.B.E., D.S.O., K.H.P., I.M.S., D.D.M.S., Northern Command, India for permission to send this account for publication, and to Major T. W. Davidson, R.A.M.C., recently commanding No. 10 Field Ambulance, and to Major G. K. Fulton, R.A.M.C., for the photographs taken during an actual action and elsewhere and their notes on the use of the apparatus.

## Travel.

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### PORTUGAL: CHANGE, CHEAPNESS AND CHARM.

By MAJOR-GENERAL HOWARD CARR, C.B.

LUNCHING recently in the Millbank Mess, I mentioned, perhaps unduly optimistically, that I had discovered the ideal holiday resort and refuge for seekers after winter sunshine and warmth; combining restful peace, ease of access and cheapness. These remarks excited so much interest that I suggested to the Editor that if I sent him a few notes on my journey and personal experiences they might prove useful, as so many of the Corps desire a cheap residential quarter on the Continent free from all the amenities of the various Riviera much-boasted places.



Praia da Rocha.

My find is Praia da Rocha, Portimao, in the Province of Algarve, Portugal—on the Atlantic in Lagos Bay—close to Cape St. Vincent, facing due south and protected by a low range of hills from the north. It enjoys a semi-tropical climate and vegetation.

Algarve is that province of Portugal lying south of the Tagus, about one-fifth of Portugal, and is almost unknown to Englishmen, most of whose knowledge of Portugal is acquired by a visit to Lisbon, Cintra, Estoril and the well known towns of the north.

Praia da Rocha derives its name from its beach with curious rock formations. The beach is most extensive, composed of fine clean sand,

very flat, with breakers which should lend themselves to surf-riding, and perfect shelter for sun-bathing ; there are numerous caves and curious arches made by erosion of the soft red sandstone.

The whole country bears testimony to the Moorish occupation, it being their last stronghold in Portugal. The towns contain old forts, typically Moorish. The gentleman tilling the land uses a wooden plough drawn by oxen or mules, and digs with the same implement as used by the Indian ryot. Water is raised by sukeyas turned by a blindfolded bullock, and donkeys are the most popular mode of village transport.



One of the beaches—summer time.

I think the easiest way to give information of practical utility is to describe in detail my own journey from start to finish, and the impressions I formed as a resident.

As Southampton was my most convenient port of departure I had the choice of lines calling at Lisbon, which is the port of entrance. Having previous experience of the Rotterdam Lloyd Company, I selected that line in preference to the Royal Mail, although both are equally good and are the same price. I booked a second-class berth, leaving Southampton on

November 12, and had a single berth cabin with every luxury one could wish for—return ticket £11, available for one year.

The "Dempo" pulled out at 5 p.m. punctually on Friday, the 12th, and being fortunate in having a smooth passage arrived at Lisbon on Monday, 15th, at 7.30 a.m. All baggage was put on shore by the Company and conveyed to the Customs sheds by Portuguese porters and dumped in a heap, from which one had to seize one's own belongings, having first obtained, on presentation of one's passport, a permit to land a fixed number of packages. Armed with this document, after rescuing one's belongings and getting them on to the bench, the examination for Customs was got through fairly easily; the only question put to me was concerning tobacco, but the number of packages must absolutely correspond with the number on the permit, and I had to add a small attache case and a bundle of sticks to make my tally correct. Another set of porters then took possession, and finally one reached the exit and could load on taxis or motor buses. My departure was further complicated by having to clear my motor car and get my documents signed by the Customs; in this I was assisted by the representative of the International Auto-Association who had been notified of my arrival by the British A.A. All this entailed the payment of what seemed to me a never-ending demand for about 20 escudos.

Having at length got clear, with my baggage loaded on my car, we crossed by ferry to the south bank of the Tagus and took the road to Algarve, via Setubal and Ferriera—about 200 miles. The road surface is excellent and the drive interesting, but rather too long—there are miles of up and down grades with sharp turns every quarter of a mile or less, but there are also long stretches absolutely straight on which we touched fifty-five to sixty miles by the speedometer.

We halted at Ferriera for a meal, which we partook in a little restaurant. There was no business doing, but after a wait the house produced a dish of boiled fish and potatoes, followed by an excellent dish of fried pork steak and chip potatoes, with a dessert of apples and bananas, and red and white wine in abundance; for this the charge was 9 escudos per head, equal to 1s. 8d. The Portuguese driver sat at the same table with us, and the girl who waited leant with both hands on the table and conversed all the time. She told my Portuguese friend that she had never before spoken to an English gentleman. We arrived at the Hotel Rocha at 7.30 p.m., in time for an 8 o'clock dinner.

This hotel is the principal one. There is one other that the English patronize; both are quite comfortable and well run. The "Rocha" has about forty bedrooms and is under English management, having recently been taken over by a Mr. and Mrs. Muir, who are making progressive improvements, both structural and in the furnishing. I have an excellent bedroom looking over the sea, about fifty yards distant, quite well if plainly furnished, for which I pay 35 escudos, inclusive of wine; baths, extra 5 escudos—this is equal to 7s. 3d. The food is good, well cooked and served English fashion.



The first two days were disappointing, as there was rain with a high wind, but not cold. My window was at all times wide open, even at night, and one light blanket was sufficient covering. As I write there is glorious warm sunshine with a cool breeze. The air and water are sufficiently warm to allow the young members of the community to appear in sun-bathing dress—this on November 20. The dress that one needs on a normal summer day at home is quite adequate, although after sundown it gets colder.

There are plenty of villas to be hired by the month, varying in price according to size from £8 to £10 per month, fully furnished but not luxurious. For a stay of a couple of months I fancy the hotel would be



A carinha, with Hotel Rocha in background.

best, unless a family with children had to be accommodated. The hotel has ample bath rooms, each bedroom has hot and cold running water and the beds are quite comfortable—although not exactly Vi. sprung—and scrupulously clean, as is the whole establishment. The floors are plain polished hard wood; no superfluous curtains, carpets or hangings; the public rooms are not numerous, but in hot weather would be little used, as there is a fine broad verandah facing south and the sea.

At the time of writing there are about twenty people in the hotel, all British, and two tables for bridge can be filled. Practically all are ex-Service people. There are four or five villas occupied by English families who have been here for some years for reasons of health, of which more anon.

Regarding the amenities of Rocha—it is a very quiet little village. The Casino is only open for badminton and tennis, there is no gambling or

music, during the winter months. A 9-hole golf course has just been made and, I am told, will provide an excellent sporting sand dune links—the “greens” are “browns.” Residents in the hotel can play for half the fees, as the proprietor has subscribed liberally to the funds of the syndicate leasing the land and has secured that privilege for his clientele. The fees are: Men, £2 for three months; women, £1. Men, £1 for one month; women, 10s. Caddies, 1.50 escudos for 9 holes, i.e. 3½d. There is boating of a rough kind and it is possible to get taken out in a boat of the sardine fleet from Portimao, where there is a flourishing sardine canning industry.

Praia da Rocha is virtually a suburb of Portimao, only about one kilometer distant. Three quarters of an hour's drive up a well-surfaced and graded road, 2,000 feet up, is Caldas da Monchique, where are the famous hot mineral springs and ancient baths. These are most interesting; there are two distinct sets of baths, one very ancient, going back to 1400. New modern baths have been quite recently constructed and equipped with absolutely the latest apparatus, the installation being supervised by a German expert. There is an excellent Ear, Throat and Nose Department with the very latest appliances for chronic and lavage treatment. A highly qualified English-speaking doctor is in charge.

There are numerous places of interest to visit; all the roads are excellent, quite up to English standard, and motor cars can be hired at very reasonable rates.

Now as regards climate. In “Playtime in Portugal,” a book that everyone who contemplates a visit to the Algarva Province should read, it is stated that “you can be naked all the time; even at midnight the sea is still warm.” This is not literally true. There are days when the sun is behind a cloud and one is glad to wear a fairly thick suit, and in December and January quite a strong wind blows for some days, but there is no venom even in an East wind, and the sun is glorious. It is said to be warm in summer in Praia da Rocha, but I do not think sufficiently so to disturb those accustomed to the tropics and there is always a fresh sea breeze and cool nights.

The cost of living is of interest to a family man who contemplates taking a villa—of which there are a fair number—all are to let fully furnished and are supposed to contain everything necessary for the size of family they are intended to accommodate. They are let by the month, rent payable in advance and varying from 750 to 1,200 escudos per month (there are 110 escudos to the £1). The smaller ones only contain two bedrooms but the large have as many as six good bedrooms. Most of them have hot and cold running water, and all have bathrooms and good indoor sanitation, electric light, but no gas. All the drinking water is carried down from Monchique and is said to be the best in Portugal. The pipe water supply is unfit to drink; this apparently does not upset anyone as all the population drink wine, even young children. The following budget

was given me by an officer who has had a villa here for some years and who lives comfortably and keeps a good table. Rent 750, Servants 200, Market 200, Fish 100, Baker 100, Milk 30, Fuel, wood 100, Water 60, Light 50, Grocer 1,000, Beggars 10 = Total 2,500 escudos—say £23—for two people per month. Fish is cheap and plentiful, also meat but not so good. Fruit, according to season, abundant and very cheap. Figs, grapes, oranges, flowers in profusion. English stores rather dear, tea 6s. to 7s. a pound, wine dirt cheap, tobacco and whisky about the same as in England, Portuguese brandy good, about 4s. a bottle, coffee excellent.

I cannot, for a short stay, recommend bringing out a motor car, as carriage hire is very reasonable, 1s. 1d. for a taxi to carry four from Praia



Drinking water from Monchique.

da Rocha to Portimao; a two wheel carinha can be had for the same journey for 2½d. a head, i.e. 1 escudo. The cars for hire are excellent saloons, either Ford, Opel or some other American or German make. My Vauxhall is the only one of its kind here and the only one in the hotel.

The Portuguese maids are hard working and do all the work of a house including washing. They work for 15s. to 20s. a month living in the house and, I think, provided with uniforms.

From Lisbon there are only two fast trains a week, on Wednesday and Saturday, taking about five hours to reach Portimao. There is a slow train every night and a goods train, with a passenger carriage attached, each day. The fare first class by Rapido is £1.

The item in the budget "Beggars" requires explanation. By law beggars are permitted to knock at your door on Saturday and solicit alms; the legal amount is 10 centavos, about a farthing, and I have been told that if given more they tender the change.



## Current Literature.

MONTEL, E. L. La fièvre typhoïde des vaccinés. [Typhoid Fever in the Inoculated.] *Arch. Méd. Gén. et Colon.* 1937, v. 6, 243-50. [154 refs.]

The author maintains that there is no special form of typhoid fever in the inoculated characterized by a mild course, or in any way different from ordinary typhoid, as he shows by an analysis of 25 cases which he has observed during the last ten years. As regards the bacteriology, 22 were due to *Bact. typhosum*, 3 to *Bact. paratyphosum A*, and none to *Bact. paratyphosum B*. The interval between the inoculation and the onset of typhoid ranged from forty-five days to eleven years, 20, or four-fifths, of the cases occurring within the first year after inoculation and usually between the sixth and seventh month. Eight of the patients had been given one injection, 16 two and 1 four. Lipovaccine was used in 22 and heated TAB vaccine in 3. The incubation period was of normal duration and the symptoms and complications those usually found in typhoid. The average duration of the disease was thirty-three days. Twelve per cent were mild, 20 per cent severe (apart from the three fatal cases), 56 per cent were moderate and 12 per cent (3 cases) were fatal. The attack of typhoid in the author's patients, therefore, was neither longer nor shorter nor more nor less severe than in those who had not been inoculated, so that he agrees with Garrow in regarding "the atypical typhoid fever in the inoculated" as a myth.

J. D. ROLLESTON.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

GOLDSMITH, A. W.; MILLER, A.; BUCHANAN, G. Endotoxoid Inoculation against Typhoid. *Proc. Transvaal Mine M. Officers' Ass.* 1937, v. 17, 31-44, 4 charts.

Between 1930 and June, 1937, the number of cases of enteric among the Natives employed on the gold mines was 6,611, of whom 1,842 died, 3,593 were repatriated and 1,176 went back to work on the mines after recovery. Neither the morbidity rate nor the mortality rate has shown a decline over this period, despite improvements in "compound" hygiene. The carrier problem is specially important owing to the Native habit of feeding from a common dish and the use of fingers in feeding. Post-mortem examinations show that carriers are recruited from the kraals. It is estimated that the present incidence results in an annual loss of 100,000 shifts, the cost of which cannot be effectively calculated, and hospital expenses of nearly £5,500. The total cost of inoculation for a Native labour force of 300,000 would be about £5,600. If inoculation would materially lessen the incidence there is a clear economic case in its favour. The benefit of endotoxoid vaccine is illustrated by the experience of various mines in which it has been employed. For instance, a mine of 8,200 boys

had twenty-five cases between December, 1934, and November, 1935, and twenty-seven cases between December, 1935, and November, 1936. In December, 1936, inoculation was started and between then and September, 1937, there were sixteen cases, only one of whom had been inoculated. On another mine practically every Native had been inoculated by the end of 1934; during 1935 no cases of enteric occurred and the few cases since then have been mainly paratyphoid.

The Native labourer must also tend to spread infection to people outside the mines.

The seasonal incidence is pronounced, with an annual rise in the summer months (December to March) and a peak between January and March. Inoculation should, therefore, be carried out during October and November.

After discussion of the practical difficulties of inoculating the whole labour force, of the pros and cons of reserving inoculation to times at which there was evidence of an outbreak on a mine, and of the importance of preserving hygiene measures even if inoculation were extensively introduced, the following resolution was passed:—

“That this Association of the T.M.M.O.A. [Transvaal Mines Medical Officers' Association] recommends the prophylactic inoculation against typhoid fever with endotoxoid vaccine of all Native labourers arriving on the mines, and that this inoculation be started immediately.”

A. BRADFORD HILL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

LANCET, 1937, Dec. 18, 1437. **Dysentery in Great Britain.**

—, 1462. **Prevalence of Dysentery.**

The Registrar General's returns show an increase in the notifications of dysentery since 1935 with a greatly enhanced incidence in the autumn of 1937, dating from the thirty-fifth week. The higher levels of 1935 and 1936 compared with those of previous years are made still more apparent when the figures for the public mental hospitals (given in the annual reports of the Board of Control) are deducted from the totals. The remaining figures for 1935 and 1936 are respectively double and treble that for 1934, and it is not unlikely that the figure for 1937 will be tenfold. The same tendency to increase appears to be true of many European countries. Increased interest in the disease and a correspondingly improved standard of diagnosis may be a partial factor, but is unlikely to be the whole explanation.

It may safely be said that infection with the Sonne bacillus is endemic in Great Britain, and with the growing popularity of foreign travel importation of the presumably more toxic Continental strains must steadily increase.

Although infant cases still predominate there seems to have been a change in both place and age distribution as well as increased prevalence.

There is a need for early bacteriological stool examination to bring cases quickly under the necessary control and by virtue of more accurate notification give a better picture of the real prevalence of the less well-known types of bacillary dysentery in this country.

A. BRADFORD HILL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

GRUNDY, F. **An Outbreak of Sonne Dysentery.** *Med. Officer.* 1937, v. 58, 251-3, 1 graph.

This outbreak at Luton was spread over August, September and October, 1937. While 302 cases were notified, sampling inquiries elicited another 118 cases and the facts suggest that the total number may have been 1,000 or more. Clinically they were mild in type, and with only one possible death. The symptoms were vomiting, diarrhœa, abdominal pain and generally a little pyrexia. Duration two to three days. Mucus and blood in the stools in only a small proportion of cases. *Bact. dysenteriæ* Sonne was isolated from the stools of a high proportion of the cases. Five out of twelve blood samples from convalescents gave a positive agglutination reaction with this organism in a dilution of 1 : 20 or higher. Detailed food investigations (including milk) gave no evidence of a common food. The water supply was contaminated to a considerable extent and temporary chlorination was adopted. It is said to have been of a transient nature. The author finds that there is not sufficient evidence to attribute the outbreak to any one article of food or drink, while its later developments are ascribed to case to case infection. [More information as to the water supply and the evidence either way as to its possible association with the outbreak would have been valuable.] W. G. SAVAGE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

SCHLIEFSTEIN, J., & COLEMAN, M. B. **An Extensive Outbreak of Enteric Disease Incited by *B. dysenteriæ* Schmitz.** *J. Infect. Dis.* 1937, v. 61, 257-8. [Abstract by the authors.]

*B. dysenteriæ* Schmitz was found to be the incitant of an extensive epidemic of enteric disease in a New York State institution in August and September, 1936. More than 200 cases were reported among over 5,000 inmates and employees; this species was isolated from the fæces of twenty-nine individuals. All of the cases were relatively mild. In two instances a temperature of 104° F. was recorded, but the reports indicated that in most of the cases evidence of little if any elevation of temperature was found. The onset was sudden, with abdominal pain followed by diarrhœa with blood and mucus which persisted for two of three days.

This type of dysentery bacillus has apparently been recognized very rarely as an ætiological agent of enteric disease in the United States. I was the incitant of a small outbreak which occurred in 1934 in another

institution in New York State, and has also been found in faecal specimens examined in the Division of Laboratories and Research from a few isolated cases during the past three years.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

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## Reviews.

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REPORT OF THE SURGEON GENERAL, UNITED STATES ARMY, 1937,  
WASHINGTON. United States Government Printing Office. Pp. 253.  
Price 25 cents.

The mean annual strength of the United States Army during 1936 was 164,654, 71 per cent of whom were whites.

The total number of enlistments was 71,331 ; 97 per cent were whites, the remainder being coloured, Puerto Ricans and Filipinos.

As regards the health of the Army there has been a slight downward trend in the admission rate which stood at 633 per 1,000. Statistics are prepared from reports on soldiers "admitted to sick reports" rendered by medical officers of Commands.

The principal causes of "admissions to sick report" of white enlisted men in order of frequency were athletic exercises, bronchitis, influenza, tonsillitis and gonorrhœa.

The greatest relative amount of sickness amongst white soldiers was in China and in Panama where respiratory diseases, malaria and venereal diseases headed the list.

It is pointed out that increase in respiratory diseases occurs in the early part of the year, while in Panama and the Philippine Islands the sick rate goes up during the summer months, due to insect-borne diseases, malaria and dengue.

The death-rate for the whole U.S. Army was 4.03 per 1,000, slightly higher than that of 1935.

There was a decline in deaths from disease and an increase in those from injuries. In 1930 automobile accidents became the leading cause of death and have remained so; they were responsible for nearly one-sixth of all deaths during 1936.

Discharges for disabilities for the total Army showed a rate per 1,000 of 14.1.

Sixty-five per cent of enlisted men discharged for physical disability had served less than two years. It is suggested that the disabilities in many of these cases should have been detected at the time of enlistment. The fact that 55 per cent of them had disabilities which existed prior to enlistment appears to corroborate this. A more thorough and careful primary medical examination is the answer.

The leading causes of discharge were dementia præcox, tuberculosis and pes planus, while nervous and mental diseases accounted for 36·9 per cent of all discharges.

Slightly more than 5,000 men were ill each day, giving approximately a rate of 3 per cent of the strength of the Army.

The non-effective rate is an index of the force of morbidity upon the man-power of the Army. It is computed by dividing the total number of days lost in any period of time by the number of man-days in the period. For 1936 it stood at 30·5 per 1,000.

The greatest loss of time was due to venereal disease.

The total number of working days lost for the year in question was 1,841,813, compared with 1,387,854 for 1935.

The average time per case in hospital was 17·6 days.

The rates for the principal infectious diseases for the total Army were :—

Influenza .. .. .	27·3	per 1,000
Pneumonia .. .. .	3·6	„ „
Venereal disease .. .. .	36·0	„ „ (Average days per case = 47·7)
Malaria .. .. .	7·5	„ „
Tuberculosis .. .. .	1·7	„ „

Rates for principal general diseases in the Army were :—

Acute rheumatic fever .. .. .	0·4	per 1,000
Nervous system .. .. .	12·5	„ „
Diseases of the ear .. .. .	5·8	„ „
„ „ eye .. .. .	6·5	„ „
„ „ circulatory system .. .. .	14·1	„ „
Includes :—		
Hæmorrhoids .. .. .	4·9	„ „
Arteriosclerosis .. .. .	1·3	„ „
Myocarditis .. .. .	0·6	„ „
Varicose veins, &c. .. .. .	0·4	„ „
Diseases of the respiratory system .. .. .	123·2	„ „
„ „ digestive system .. .. .	128·9	„ „
Includes :—		
Tonsillitis .. .. .	23·3	„ „
Appendicitis .. .. .	11·6	„ „
Hernia .. .. .	4·5	„ „
Diseases of the skin and cellular tissue .. .. .	47·5	„ „
Scabies .. .. .	4·9	„ „
Injuries .. .. .	119·8	„ „

Work carried out by the Planning and Training Division of the Surgeon General's Office included progress in perfecting a cross-country motor ambulance for use immediately in rear of the front line.

For highly-specialized units of the surgical hospital, semi-trailers and van type bodies are being utilized. These vehicles will include operating rooms and sterilizing room vans. An anæsthesia apparatus has been developed and is being installed in one of the operating room vans.

A new Physiological Research Laboratory at Daytona, Ohio, has been

completed, and is considered one of the finest institutions of its kind in the world. A large number of important research projects connected with aviation were considered during 1936; many of them are studies of the physiological effect of altitude on the aircraft personnel.

D. T. R.

ANNUAL REPORT OF THE SURGEON GENERAL OF THE PUBLIC HEALTH SERVICE OF THE UNITED STATES FOR THE FISCAL YEAR 1937. Washington: U.S. Government Printing Office. 1937. Pp. vi + 164. 60 cents, cloth.

In this report are summarized the principal activities of the United States Public Health Service during the year under review.

The general death rate in twenty-five States was 11.3 per 1,000 for 1936, an increase of 5 per cent over 1935. The infantile mortality rate was 56.9 per 1,000 live births, 1.3 per 1,000 higher than the average of the five years 1932 to 1936 inclusive.

The decline in maternal mortality rate has continued: the figure for 1936 standing at 5.1 deaths per 1,000 live births.

There were no cases of cholera or yellow fever and only four cases of human plague.

Poliomyelitis incidence was unusually low, less than half that for 1935, as was also that for typhoid fever, whooping-cough and diphtheria. Smallpox cases numbered 7,820 cases as compared with 7,897 for 1935. Fortunately the cases were mild. A warning is given that a virulent type might at any time appear, and the only means of preventing this is a better vaccinated population.

With regard to tuberculosis there is evidence that the downward trend in the mortality which has continued since 1918 has received its first check.

Some of the Special Public Health activities dealt with in the Report are mentioned below.

Widespread support and publicity for control work in venereal disease resulted in increased facilities being provided by many of the States for treatment and also for expert advisory assistance. Arrangements for training selected physicians in the public health control and clinical management of venereal diseases have been effected at several of the leading clinics.

Heart disease studies were mainly confined to consideration of the rheumatic type of the disease. The year in question showed a marked reduction of cases which was general among Eastern cities. This pointed to the possible influence of the prevailing weather conditions in these places. In Washington the months preceding the season of prevalence were characterized by heavy precipitation and unusually high temperatures, conditions simulating those in parts of the country having a low incidence. The question of streptococcic infection being the causative agent still

remains unanswered. The analysis for 1936 revealed the fact that in about one fourth of the cases no evidence, either serological or bacteriological, of such an infection could be found. On the other hand investigation failed to demonstrate the presence of a filtrable virus claimed as the causative agent by Schlesinger. It is suggested the disease may be associated with metabolic or endocrine conditions. It is of interest to note that the scurvy-streptococcus lesion of the heart valves can be induced by endocrinal means without scurvy. The lesion is unlike that of rheumatic fever ; it is non-bacterial and proliferative.

As regards heart disease in childhood and hereditary predisposition, a study of many cases showed that the interval in time between the onset of the disease in parents and in their children favoured the theory that such heredity existed.

In connexion with hæmolytic streptococcal diseases a new method of purifying and precipitating the erythrogenic toxin of scarlet fever streptococcus has been developed. Using this material for active immunization the objectionable reactions are partly reduced ; 95 per cent of the treated children experienced no disagreeable reactions.

An investigation in Alabama and in Tennessee into the incidence of tuberculosis has brought to light an unexpected result, namely, that the incidence and mortality rates were very much higher in the country where living conditions were better and where there was a greater consumption of red meat, milk and eggs.

With regard to quarantine and immigration it is pointed out that yellow fever and plague are the principal quarantinable diseases that may be spread by maritime and air commerce.

Yellow fever, by reason of its residual reservoir of virus in South America and Africa, and the rapidity with which air travel between these countries and the United States is accomplished, constitutes a considerable problem.

The following measures are enforceable : (a) Disinsectization of aircraft by fumigatives containing pyrethrum sprayed by a special type of hand-operated sprayer. (252 inspections were made of airplanes from South and Central American parts and 24 were found to be harbouring mosquitoes —18 carried dead and 13 living mosquitoes.) (b) Surveillance of passengers. (c) Immunization of aircraft personnel.

With regard to chronic endemic dental fluorosis the quantitative relation between the fluoride concentration of communal water supply and the degree of dental fluorosis (mottled enamel) appears to be firmly established. A concentration not exceeding 1 part per million is of no hygienic significance.

The Rickettsia of endemic (murine) typhus fever was cultivated through 17 passages in modified Maitland media in Erlenmeyer flasks using guinea-pig serum, Baker's solution and guinea-pig tunica. Similarly the Rickettsia of European typhus was cultivated in the same media through 6 passages. The Rickettsia of Rocky Mountain spotted fever was cultivated in similar

media, using both chick embryo, chorio-allantoic membrane and guinea-pig tunica as tissue.

Isolation of the virus of endemic typhus from an old field mouse trapped in Alabama brought out the important fact that the disease can no longer be regarded as peculiar to cities and towns but has spread to rural areas. The gross amount of preventive vaccine during the year 1936 was sufficient for 80,000 persons. Data from increasing number of reports suggest that full protection against the less virulent strains of the virus may not be as general as was expected from the results of the first few years' use of the vaccine.

A new vector (*Ornithodoros turicata*, an argasid tick) of relapsing fever has been discovered in South Western Kansas.

The hereditary transmission of relapsing fever spirochætes from experimentally infected female ticks has been shown to occur by passage through the egg to the resultant larval and first nymph stages; these stages infected mouse, monkey or man on which they were fed.

Poliomyelitis—approximately 2,000,000 persons employed the picric acid-alum spray as a prophylactic against poliomyelitis in Alabama, Tennessee and Mississippi. The method probably failed to cover the olfactory area in many instances. The results were encouraging.

A peculiar epidemic of poliomyelitis amongst hospital personnel at Los Angeles in 1934 is reported. The spread was by contact with cases and carriers in the communicable disease wards, the admitting room and the nurses' quarters. No outbreak of poliomyelitis among nurses and physicians has previously occurred in any part of the world.

The pharmacological effect of sulphanilamide in meningococcal infection was studied. One report published shows that sulphanilamide is effective in protecting mice to a considerable degree against infection. A second report indicates that anti-meningococcal serum plus the drug protects mice far better than the sum of the protection offered by the two separately.

The prevalence of wild rodent plague has been demonstrated—squirrels (ground and tree), chipmunks, marmots and prairie dogs were all found implicated. 36,000 fleas from wild rodents were received for identification; approximately forty-five different species were identified, while a considerable number of unknown species were discovered.

Experiments on the transmission of plague by 8 different species of fleas showed that *Xenopsylla cheopis* transmitted plague much more readily than other fleas from rats or the five species from wild rodents.

An intensive campaign carried on during the two preceding years in what was believed to be the plague zone in the territory of Hawaii resulted in a reduction of the rat population in this zone to such a low point that plague was probably starved out.

The measures carried out consisted of: (1) Elimination of rat harborages in open country by clearing areas and treating burrows with carbon-bisulphide; (2) trapping; (3) applying calcium cyanide to rock piles and



other rat harborages ; (4) applying poison bait to cleared areas ; (5) clearing of underbrush in forests to prevent rats from building nests in trees ; (6) rat-proofing buildings.

As a result of rat-proofing buildings and clearing of forests *R. rattus* and *R. alexandrinus* have been markedly reduced in numbers.

Under child hygiene is mentioned the biophotometric test for indicating the presence of vitamin A in determining the nutritional status of children. Approximately 600 children were given the test. The results indicated that the test is unsuitable for general school survey and that it furnished little evidence for believing that vitamin A deficiency is prevalent among children in the communities studied.

A therapy for the treatment of oxyuriasis, never previously employed, consisting in the administration of gentian violet three times a day for ten days, has proved very much better than any other form of therapy known. The drug must be given simultaneously to all infected persons in the family.

D. T. R.

BLACK'S MEDICAL DICTIONARY. Fourteenth Edition. London : Messrs. A. and C. Black, Ltd. 1937. Pp. xvi + 1006. Price 18s. net.

Black's Medical Dictionary has long been a popular work of reference for non-medical men and women. The fourteenth edition has been fully revised and brought well abreast of present-day knowledge.

It contains an enormous fund of useful medical information put in a form easily understood by even the most unscientific reader.

This book should be of value to nurses and others with medical knowledge, as well as to those unconnected with the medical profession.

MEDICAL AND SANITARY REPORTS FROM BRITISH COLONIES, PROTECTORATES AND DEPENDENCIES FOR THE YEAR 1935. Summarized by P. Granville Edge. *Tropical Diseases Bulletin Supplement*, vol. 34, November, 1937. Published by the Hon. Managing Committee of the Bureau of Hygiene and Tropical Diseases, Keppel Street, London, W.C.1. Pp. 287. Price 7s. 6d.

The Medical and Sanitary Reports from the British Colonies, Protectorates and Dependencies contains much interesting information on many aspects of health problems arising in different parts of the world. These have been usefully summarized in this Supplement by P. Granville Edge. There is an introductory chapter on the incidence and distribution of malaria in British Colonial possessions. The writer points out how difficult it is to obtain sufficient reliable data regarding the relative incidence of specific diseases amongst these several populations. Despite these difficulties, however, useful pointers may be obtained from a study of such incomplete data. So far as the Colonial hospitals were concerned during

1935, roughly one in every five in-patients had malaria, while amongst approximately 24 million out-patients treated for all causes of sickness over 6 million cases were malarial. These figures do not include the hundreds of thousands of cases treated in mission and other centres.

A careful study of this summary is well worth while.

ALDRIDGE'S HOSPITAL DIARY. Compiled by F. P. Carroll. Published by Frederick Aldridge, 34, Paternoster Row, London, E.C.4. Price 5s.

This Diary and Desk Book is specially intended for hospital administration offices, and in addition to having a well-spaced day-to-day diary it includes a mass of useful information of all kinds for those engaged in hospital work. In particular the hospital buyers' guide provides a section giving easy reference to firms providing hospital supplies of all kinds which will be most helpful to those concerned in hospital supplies. We can recommend this Diary as a most useful book for the purpose it is intended to serve.

W. J. F. C.

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## Notices.

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### ROYAL SOCIETY OF ARTS.

#### SWINEY PRIZE FOR A WORK ON MEDICAL JURISPRUDENCE.

THE Council give notice that the next award of the Swiney Prize will be made in January, 1939, the ninety-fifth anniversary of the testator's death. Dr. Swiney died in 1844, and in his will he left a sum of money to the Royal Society of Arts for the purpose of presenting a prize, on every fifth anniversary of his death, to the author of the best published work on Jurisprudence. The prize is a cup, of a value of £100, and money to the same amount.

The award is made by a joint Committee of the Royal Society of Arts and the Royal College of Physicians, which appoints special adjudicators.

The prize is offered alternately for Medical and General Jurisprudence, but if at any time the Committee is unable to find a work of sufficient merit in the class whose turn it is to receive the award, it is at liberty to recommend a book belonging to the other class. On the last occasion of the award (1934) the prize was awarded for General Jurisprudence. It will, therefore, be offered on the present occasion for Medical Jurisprudence.

Any person desiring to submit a work in competition, or to recommend any work for the consideration of the judges, should do so by letter, addressed to the Secretary of the Society, not later than November 30, 1938.

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COMMANDANT, OFFICERS' CONVALESCENT HOME,  
OOTACAMUND.

APPLICATIONS are invited for the post of Commandant of the Officers' Convalescent Home at Ootacamund for retired European officers of the Indian Medical Service or the Royal Army Medical Corps.

The terms of the appointment are :—

- (i) Salary of Rs. 300 per mensem in addition to retired pay, plus free quarters, lighting, fuel and board for himself and his wife, who will assist him.
- (ii) The tenure will be for so long as the officer's services are required, and will be subject to three months' notice on either side.
- (iii) The officer will normally be required to vacate the appointment on attaining the age of 57. An extension for a specified period may, however, be granted.
- (iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorised representative shall be the sole judge.

2. Applications should be addressed to the Director of Medical Services in India, Army Headquarters, Simla, and should reach him by July 15, 1938. The selected officer will be required to join the appointment on October 15, 1938.

3. This supersedes the "Notice" published in the February and March issues of the Journal.

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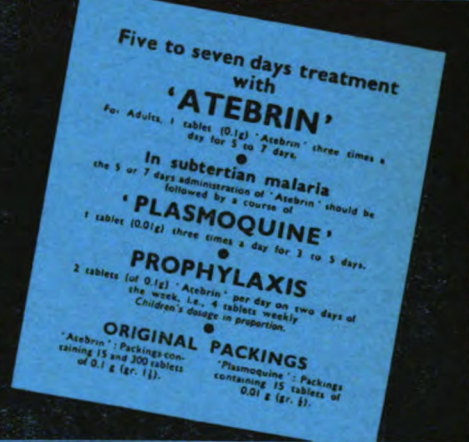
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# Journal

OF THE

# Royal Army Medical Corps

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COLONEL SIR WILLIAM H. HORROCKS, K.C.M.G., C.B.

ASSISTANT EDITOR :

COLONEL D. T. RICHARDSON, M.C.

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MANAGER.

MAJOR W. J. F. CRAIG, R.A.M.C.

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SIR WILLIAM HORROCKS.

## Foreword.

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### OUR EDITOR.

WITH the issue of the Corps Journal for June, 1938, Colonel Sir William Horrocks completed thirty years' service as its Editor.

In 1908 the Journal had no Assistant Editor, so that for Major Horrocks, as he then was, to undertake the editorship, in addition to the research work which was then bringing him an international reputation, was no small undertaking. Sir William, however, devoted himself to the interests of the Journal from the very beginning, and with a parent's care has brought his charge through the trials of youth to successful maturity and world-wide recognition. He has himself contributed many valuable scientific articles to its pages, in addition to the Editorials which appear in each issue. His skill in reducing the prolixities of the English language to simplicity and directness is almost unequalled, as all who have contributed to its pages will agree. The passing of the years has brought no diminution of our Editor's work in the cause of military medicine, and it is confidently felt that all readers of the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS will congratulate Sir William Horrocks on his wonderful record.



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# Journal of the Royal Army Medical Corps.

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## Original Communications.

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### MEDICAL STANDARDS OF RECRUITS ONE HUNDRED YEARS AGO.

BY COLONEL D. T. RICHARDSON, M.C.

FROM a volume entitled "The Enlisting, Discharging and Pensioning of Soldiers," by Henry Marshall, F.R.S.E., Deputy Inspector-General of Army Hospitals, published in the year 1839, some very interesting facts come to light. Marshall, in his preface, gives thanks to Sir James McGrigor "for his liberality in offering me permission to examine the valuable documents in the record room of the Medical Department of the Army." We must presume, therefore, that the information, both historic and statistical, which the book contains is founded on authentic records.

#### REQUIREMENTS.

The average strength of the British Army for the years 1819 to 1828 was 100,214. There was an annual wastage of 8,000, to replace which 12,000 recruits were required yearly.

All soldiers enlisted voluntarily on a long service contract of twenty-one years.

#### THE MEDICAL EXAMINATION.

It does not appear that recruits were generally examined by a medical officer before 1790. Prior to this date probably a great deal of the recruiting was carried out by a non-medical staff, who, no doubt, frequently called in a surgeon to decide on borderline cases. In 1799 an order was issued directing that "The Chirurgical testimony" of the fitness of a recruit should be certified on the back of each attestation. In 1802 a new class of medical officers was appointed, namely, District Surgeons, who

## 2 *Medical Standards of Recruits One Hundred Years Ago*

were employed in Great Britain and Ireland in the recruiting districts to examine recruits.

They were usually selected from old Regimental or Staff Surgeons. The pay was 10s. a day without allowances.

In 1820 the regulation for the instruction of medical officers connected with the recruiting department contained little or nothing to guide them, and much was left to their own discretion.

In 1824 a new code of regulations to medical officers was promulgated by the Medical Department, and in 1830 the instructions existing at the time of Marshall were brought into force.

These instructions contain much that is familiar to those of us who study Appendix 11B, Regulations for the Medical Services of the Army. Not only is the method of examination very similar but the very phraseology of the text has altered scarcely at all, and even more surprising changes which have lately been introduced, and which have been looked upon as being somewhat revolutionary in character, were in those days in actual practice. Thus we note that no recruit is to be approved unless he possesses adequate strength for the duties which he may be called upon to perform, and the medical officer will require to take into consideration the specific duties of different branches of the Army for which the recruit may be intended.

For this purpose the Army was divided into three classes :—

*“Ordnance Department.”*—Only powerfully built and athletic men are accepted because of the heavy weights they had to lift. Their duties are not so fatiguing—their knapsacks are usually carried on wagons.

*“Cavalry.”*—They do not have to carry a pack. There is not required the same standard for chest or limbs as for infantry. The following blemishes do not disqualify men—the deformity usually denominated ‘in-kneed,’ cicatrices of ulcers on the legs, loss of great toe, moderately deformed feet and flatness of the soles of the feet.

*“Infantry.”*—The Infantry soldier is exposed in war to greater fatigue than either the artillery man or dragoons.

“On the march he carries his knapsack and accoutrements, which weigh about 62 lb. Recruits for the infantry therefore as regards health and muscular capability should be selected with even more care than the cavalry corps.”

### PROCEDURE.

Recruiting officers or serjeants of parties carried out a preliminary inspection of a recruit in regard to age, height and general appearance, and if satisfied they brought him before the medical officer.

A recruit who had been “intermediately” accepted by a Regimental Medical Officer or private practitioner was required to be examined by a District Staff Surgeon or by the medical officer of the man’s regiment.

If either of the latter disapproved, the recruit was brought before a medical board whose decision was final.

A circular letter from the War Office dated 1817 stated that, in consequence of a number of recruits who had been intermediately approved by medical officers having been rejected by the District Surgeon on account of disabilities which ought to have been discovered, the Prince Regent directed that in all such cases the expense incurred on account of the recruits should be charged against the medical officer by whom they were passed in the first instance. In consequence of this order a number of medical officers had to pay very heavy fines and the rates of recruits rejected was greatly increased. This order was rescinded in 1822.

#### MEDICAL AND PHYSICAL STANDARDS.

Let us now examine the individual standards :—

*Height.*—It is pointed out that stature is no concern of the medical officer, who only considers it in relation to weight and chest measurement as a measure of physical power. Very tall men are said to be deficient in energy and comparatively incapable of enduring fatigue, whereas men of medium height are commonly very efficient soldiers, being often as powerful as tall men and more able to undergo severe exertion.

The minimum height for infantry was 5 feet 5½ inches to 5 feet 6 inches; the mean height of recruits between 5 feet 7 inches and 5 feet 8 inches. The minimum height of the French soldier was 5 feet 2 inches.

Since writing these notes a diary of a forebear who was adjutant of the 45th Regiment of Foot (Sherwoods) was shown me. In it there is a list of ninety men of his Company. The regiment, prior to embarkation for Buenos Aires, 1807, recruited at Cork, where the regiment was stationed, and from a glance at the list of names nearly 85 per cent appear to be Irish. The Adjutant was a Scot, so Nottingham and Derby had no reason to blow the regimental horn about the battle honours.

The average height of the Company was 5 feet 7 inches.

*Weight.*—No weight standard appears to have been in existence as Marshall mentions age as being the sole judge. He, however, recommends the following minimum weights for varying ages :—

17 years	..	..	..	116 lb.	9 oz.
18 "	..	..	..	127 "	9½ "
20 "	..	..	..	132 "	7½ "
25 "	..	..	..	138 "	12½ "

*Magnitude of Chest.*—The minimum chest measurement was 30 or 31 inches at the minimum height.

The average circumference of the chests of 1,439 recruits whose heights varied from 5 feet 5 inches to 6 feet 6 inches was shown to be 32.50 inches.

There is no mention of where the measurement was taken or whether the chest was fully expanded or not; the figure is a remarkably low one.



#### 4 *Medical Standards of Recruits One Hundred Years Ago*

*Age.*—The minimum age of recruits for regiments serving in India was 20 years; for regiments serving elsewhere no specific age was fixed. Provided a youth attained the minimum height he was accepted however young he was. The maximum age was 24.

Marshall expresses doubt as to the advisability of taking boys as young as eighteen. He argues that great and long protracted exertions, whether in marching with a heavy knapsack or in military exercise, tend to exhaust the frame, especially of striplings, who however willing are unable to undergo the fatigue of work which men a few years older are capable of executing with ease. The efficiency of soldiers, he adds, depends upon their capacity for executing long marches with comparative ease. Young lads will fight with great gallantry, but they cannot stand up to long marches in wet weather or upon heavy roads. He strongly recommended the minimum age to be raised to 20. Napoleon very often used to transport his young infantry soldiers by post-carriage to preserve their fighting efficiency.

Although the mortality rates for disease amongst young soldiers in war due to the fatigue and strain of marching and fighting were higher than for older men, the reverse was the case in peace time. In a table there is shown annual mortality rates during peace for the age-groups 18-25, 25-33, 33-40, and 40-50, and for stations at home and abroad. In almost every case the rate increases as the age-groups become older. Jamaica, as it does to-day, held the premier position of being the most unhealthy station abroad—one man in seven died annually there.

Marshall considers the maximum age should be no higher than 24, as above this age the recruit has not the flexibility or freedom of motion which is necessary for acquiring the discipline of a soldier, and corpulency, to a certain extent, supervenes—with more or less prominence of the belly.

Another objection he has to accepting men over 24 is that they are habitually dissipated and profligate characters or persons unsuccessful in business, broken-down gentlemen, discharged soldiers, deserters, etc.

The effective military age he places between 20 and 40.

In general, the estimation of a healthy recruit was based on the following criteria: a just proportion between trunk and different members of the body, a countenance expressive of health, with a lively eye, skin firm and elastic, lips red, teeth in good condition, voice strong, chest capacious and well formed, belly lank, limbs muscular, feet arched and of a moderate length, hands rather large than small.

It was realized that the determination must be left to the discretion and experience of the medical officer. So varied was the medical opinion that out of 3,000 recruits one medical officer would reject two-thirds, while a second would accept that number.

Causes of rejection included: (1) Impaired vision from whatever cause; no standards are given. (2) Deafness, copious discharge from the ears. (3) Loss of many teeth or teeth generally unsound. Front teeth, i.e.

incisors and canines, were necessary for "tearing a cartridge," as well as for biting food. (4) Varicocele—but Marshall, although he admits that it may give an occasional pain and inconvenience during much fatigue, had never occasion to admit a soldier into hospital on account of the disability. (5) Flat feet. Many of the slighter deviations from symmetry did not disqualify, but men who had the soles of the feet not merely flat but in some degree convex, making them walk unsteadily and suffer fatigue rapidly, were ineligible. It was emphasized that care should be taken not to confound the "broad" with the flat foot.

#### VACCINATION.

Every recruit who has not passed through smallpox or vaccine disease is, if possible, to be vaccinated by the inspecting medical officer.

#### SIGNS OF PREVIOUS DISEASE, ETC.

Amongst the signs of previous disease or previous service were leech bites, traces of blisters, cuppings, and of corporal punishment. The letter D was tattooed on every man who had deserted, and this was to be sought for.

#### CHARACTER AND EDUCATION.

There appears to have been no attempt made to obtain a "character" of the applicant as was practised in the case of hiring servants, nor were educational attainments recognized as a special qualification. In an estimate of the educational standard of recruits raised in Scotland it was shown that 7 to 10 per cent could neither read nor write. The present situation, in spite of compulsory education, appears to be little changed.

The Report on the Army, 1937, states that of 23,888 recruits from all districts in the United Kingdom and taken on the regimental strength 2,122 (8·9 per cent) were practically illiterate, while 5,287 (22 per cent) could only read very elementary books and write simple dictation.

#### REJECTION RATES PER 1,000.

In the twelve years from 1826 to 1837 the annual rejection rates for the ten recruiting districts in the United Kingdom were as follows :—

Dublin	Cork	Newry	Edinburgh	Glasgow	London	Leeds	Coventry	Bristol	Liverpool
38·3	25·6	20·7	36·0	27·3	26·4	29·1	18·3	25·8	25·4
Average for all districts					..	..	..	27·3	

A table also shows a much bigger rejection rate of town than of country recruits. The ratio of rejections of town recruits for Dublin, Edinburgh and London averaged 47 per 1,000 and for country recruits 15·8 per 1,000.

Competent authority alleged that agricultural labourers abundantly supplied with food became the most trustworthy soldiers; recruits enlisted in manufacturing districts and large towns were frequently idle and dissolute, and required all the means in the power of their officers to

## 6 *Medical Standards of Recruits One Hundred Years Ago*

correct intemperate and vicious habits in which they indulged and to enforce subordination.

It does not appear from the following note that the soldier's family provided the next generation of soldiers, for it is stated : "A very small proportion only of the children of soldiers reach the age of manhood, and those who survive the privations and exposures they undergo, are commonly stunted, often scrofulous and frequently vicious."

### DISCHARGE OF SOLDIERS.

Many recruits enlisted either when under the influence of alcohol or because of pique, and realizing they had sold their freedom and lives for some twenty odd years, made every effort to obtain release by fair or foul means—feigning disease was extremely common, and there was no limit to the length they went in the attainment of their object.

#### CAUSES OF REJECTION—RATES PER 1,000, DUBLIN 1827-1828.

Unsound health	..	..	..	..	..	..	..	18.5
Weak intellect	..	..	..	..	..	..	..	1.9
Traces of scrofula	..	..	..	..	..	..	..	10.8
Muscular tenuity	..	..	..	..	..	..	..	10.8
Chronic cuticular affections	..	..	..	..	..	..	..	3.9
Traces of tinea capitis	..	..	..	..	..	..	..	2.7
Ophthalmia tarsi	..	..	..	..	..	..	..	2.7
Obscurity of the cornea	..	..	..	..	..	..	..	4.2
Specks on cornea	..	..	..	..	..	..	..	10.0
Cataract	..	..	..	..	..	..	..	4.6
Puriform discharge	..	..	..	..	..	..	..	0.8
Deafness	..	..	..	..	..	..	..	0.4
Loss of teeth	..	..	..	..	..	..	..	3.1
Impediment of speech	..	..	..	..	..	..	..	0.8
Excessively large tonsils	..	..	..	..	..	..	..	0.4
Want of due capacity of the chest	..	..	..	..	..	..	..	1.5
Defective condition of the superior extremities on account of old fractures, contractions, mutilations, extenuations, deformity, ganglions, etc.								
Fracture of one or both of the clavicles	..	..	..	..	..	..	..	1.9
Deformed spine	..	..	..	..	..	..	..	3.1
Hernia	..	..	..	..	..	..	..	6.2
Laxity of the ring of the exterior oblique muscles	..	..	..	..	..	..	..	8.5
Varicose veins left spermatic cord	..	..	..	..	..	..	..	3.9
Left testicle strangulated in the ring	..	..	..	..	..	..	..	0.4
Testicles enlarged	..	..	..	..	..	..	..	1.5
Gonorrhœa	..	..	..	..	..	..	..	0.4
Syphilis	..	..	..	..	..	..	..	3.1
Hydrocele	..	..	..	..	..	..	..	4.2
Defective condition of the inferior extremities from old fractures, malformation, extenuations, enlargement, disproportioned length, bunions, ganglions								
Varicose veins	..	..	..	..	..	..	..	28.6
Ulcers, wounds or cicatrices of injuries	..	..	..	..	..	..	..	18.5
Traces of issues chiefly on the back of the neck	..	..	..	..	..	..	..	3.5
Flatness of the soles of the feet	..	..	..	..	..	..	..	6.2
Traces of corporal punishment on the back	..	..	..	..	..	..	..	9.1
Mark of the letter D under left arm-pit	..	..	..	..	..	..	..	0.4

Every conceivable disease—epilepsy, palsy, insanity, rheumatism, hernia, blindness, ulcerations—was either simulated or intentionally reproduced, nor did 1,000 lashes deter the malingerer from his set purpose. Hernias were produced by incising the scrotum and inserting the stem of a clay pipe, and with the assistance of a pal, blowing until the skin was as tight as a drum. Men were quite prepared to lose the sight of one eye if it should get them their discharge. This was done by the application of a caustic, by scraping the surface of the cornea, or by piercing it with a sharp needle and scratching the lens to cause cataract.

Jamaica as a station was so dreaded that to avoid it mass malingering was resorted to. In one instance 300 of a regiment blinded themselves with the pus from a gonorrhœal patient.

For months on end men would limp, or crawl on all fours; would feign deafness or dumbness or behave like imbeciles with such skill and unrelaxing determination that try as the doctors could they were very often unable to catch the soldier out. It is little wonder that the strictest orders were published instructing medical officers to exercise the greatest caution in proposing soldiers for discharge.

Were the disability a genuine one, before discharge was considered the question of whether it rendered the man permanently unfit for military service had to be answered. For instance blindness in one eye would disqualify a recruit from enlistment, but occurring during the soldier's service it was not recognized as a cause of discharge, for the soldier was fit enough to serve in some capacity or another.

In the specimen Form No. 2, "The Record of a Soldier's Service" shown completed, we find the soldier named is Thomas Atkins—was this the origin of the nick-name? If so, perhaps something more about the original would be of interest.

Thomas Atkins was born in the Parish of St. Mary in or near the town of Portsmouth in the County of Hants, was enlisted at Coventry for the 5th Regiment of Foot on May 6, 1806, at the age of 17. He was by trade a labourer. After twelve years' service he rose to the rank of Serjeant-Major but was reduced to the rank of Private, for what reason is not mentioned. In seven years he had regained the rank of Serjeant, when he was found unfit for service after one month's treatment in the general hospital, and discharged the Service aged 40 years. He served two years in the East Indies, two in the West Indies, six at Gibraltar, two in the Peninsular, and the remainder at home. He was wounded in the leg at Waterloo and was also present at the siege of Bhurtpore, when he distinguished himself at the storming of the place.

The character which he was given on discharge speaks of him as being a well-conducted soldier who has distinguished himself by several acts of bravery, and in consequence of his long and meritorious service he has received a special gratuity of £— in addition to the pension to which he is entitled (2s. 4d. a day).

## THE CHEMICAL TREATMENT OF SULLAGE WATER IN CAMPS AND BARRACKS.<sup>1</sup>

BY LIEUTENANT-COLONEL E. F. W. MACKENZIE, O.B.E., M.C.,  
*Royal Army Medical Corps.*

AND

MAJOR F. C. HILTON-SERGEANT,  
*Royal Army Medical Corps.*

REPORTS are frequently received with regard to difficulties encountered in disposing of sullage water in a satisfactory manner. These difficulties have arisen particularly in camps of moderate duration, in standing camps and in hutments—in fact, in those situations in which a piped water supply may be provided, but in which it is usual to omit the provision of a suitable system of drains to carry away the waste water.

As a result of these reports an endeavour has been made to apply to camps, and to barracks for which no water carriage system of sewage removal has been provided, the process for the chemical treatment of sullage water by means of ferrous sulphate and lime advocated by Hattersley (1935).

This process furnishes a non-putrescible effluent containing less than 1 part per 100,000 suspended solids. The dissolved oxygen absorbed by the effluent exceeds the 2 parts per 100,000 recommended by the Royal Commission on Sewage Disposal (8th Report) for those occasions on which the volume of the stream receiving the effluent is less than 150 times that of the effluent discharged into it.

In situations where soakage is good the effluent can be disposed of in large quantities by means of soakage pits, and where little or no soakage takes place the chemical treatment greatly facilitates the subsequent disposal of both sludge and effluent without offence.

It was early realized that the two main difficulties to be surmounted in attempting to adapt this process for use in the situations set forth above would be :—

(1) The collection of sullage water from the various producing units of a camp (ablution benches, kitchens, dining tents, etc.) into a central area for treatment in bulk, and

(2) The provision of a sufficient fall to permit of the collection of sullage and the drawing off of effluent after treatment without the necessity of lifting to a higher level by pumping.

As regards the collection of sullage water it was considered that, if a treatment plant were provided for each producing unit, the inoffensive effluent might be run off in surface drains or soaked away. The sludge, on the other hand, would have to be either lagooned in an unsightly pool nearby, or carted away daily. A large number of small plants would require

<sup>1</sup> This article should have preceded the paper by Major T. F. Kennedy on the chemical treatment of sullage water which was printed in the June number of the JOURNAL. In his paper Major Kennedy referred to the experimental work carried out at the School of Hygiene.

to be treated and this would involve, in addition to treatment and the drawing off of effluent, the daily removal of sludge. This necessity appeared to invalidate local treatment.

Camp sites do exist in which these difficulties can be overcome by careful consideration of the exact siting of the camp and water supply and the layout of sullage producing units. Nevertheless, this is not the case in the vast majority of sites, and it was considered inadvisable to suggest a solution of the difficulty by adding to the already long list of features set forth as desirable in the selection of camp sites, the words "and of such a nature that sullage water can be readily disposed of by chemical treatment."

Continuous flow methods received consideration, but it was found that their utility was strictly limited, since the bulk of sullage water is delivered during comparatively short periods at long intervals. Any process involving continuous flow therefore suffers from the disadvantage that it must, of necessity, be of a size sufficient to deal with the maximum output at any one time, no matter how small the total daily output may be. A plant out of all proportion to the daily flow is therefore necessary.

#### EXPERIMENTAL WORK.

Consideration of all the facts suggested that a simple solution might be found in the use of pits in duplicate, one in which chemical treatment and sedimentation would be performed, and a second and deeper pit into which the effluent could be withdrawn and soaked away. If soakage took place in the first pit so much the better. The second pit and chemical treatment would not be necessary until the first pit became impervious.

The idea was tried out in practice and it soon became obvious that it would not live up to expectations. If soakage was good seepage from the first to the second pit took place with consequent erosion and collapse of the walls. In soil of sufficient consistency to prevent this, soakage from the second pit was too slow. Natural features therefore appeared to necessitate considerable constructional work in the shape of revetting, fencing of open pits, etc., or to preclude the use of pits, and it accordingly seems doubtful whether their use for this purpose in temporary camps is a practical proposition.

Attention was then turned to sedimentation in specially provided receptacles such as canvas tanks or casks.

The difficulty of securing a fall without lifting the sullage to higher levels appeared to necessitate the employment of shallow receptacles, equivalent capacity being obtained by increasing their area. These, on the other hand, had the great disadvantage that they considerably increased the volume of the sludge for the following reason. The sludge to be disposed of is represented, not only by the actual sludge, but also by the layer of supernatant effluent necessarily left after the bulk of it has been withdrawn. The height above the sludge to which the effluent may be withdrawn without disturbance of

sludge is constant, provided that the conditions of drawing off remain the same. Any increase in the superficial area of the container thus means an equivalent increase in the quantity of supernatant effluent which requires to be disposed of as sludge. In practice, unless the sedimentation tank is relatively of great depth, this supernatant effluent constitutes the greater part of the sludge. When shallow tanks are employed it becomes as much as three quarters of the total, and the volume of sludge to be disposed of is so great as to make the process unworkable.

A solution to this problem was found by allowing the sludge to accumulate in the tank instead of disposing of it after each treatment.

Accumulation of sludge does not adversely affect the process. On the contrary, while the effluent shows no deterioration, settling takes place more rapidly and a reduction in the dose of ferrous sulphate has been found to be possible.

As the result of these observations the method was tried out in practice.

The method employed and the details of results achieved were as follows:—

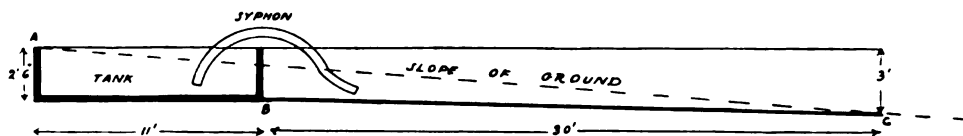


FIG. 1.—Elevation showing layout of experimental plant. A, Sullage inlet by surface drain to proximal side of tank sunk to ground level. B-C, Effluent drain 1 foot 9 inches deep at B, and reaching the surface at C.

One tank, waterproof, 1,500 gallons (as normally used for water purification) was erected in a sloping site previously prepared by excavation to such an extent that the proximal side of the tank was at ground level. This allowed the sullage to be run into the tank by a surface drain and obviated the necessity for lifting it to a tank at or above ground level. The excavation and the erection of the tank were carried out by two men in one day. The excavation alone involved the moving of 242 cubic feet of earth. This can be done by three men in one morning or by two men in one day when working in friable soil.

The slope of the ground was such that the bottom of the tank on the distal side was two feet below ground level, and it was therefore necessary to make provision for syphoning off and running away the effluent. This was satisfactorily arranged by digging a ditch of sufficient depth on the distal side of the tank and extending this ditch until it reached the surface of the ground at a distance of a few yards.

The levels and details of the lay-out are shown in fig. 1.

The ferrous sulphate in solution was added to the sullage water, thoroughly mixed by means of a paddle, and the lime was then added as milk of lime until a green floc formed. This accords exactly with the

procedure advised by Hattersley (1935), and the only departure from his method was the use of shallow tanks made possible by accumulation of sludge.

The following points are worthy of note :—

(1) Accumulation of sludge gives rise to one departure from the normal reaction, in which the end point is reached when the colour changes to green and a definite floc forms. When the old floc is left in the tank the green colour is constant. The amount of lime to be added must, therefore, be controlled by the formation of floc alone. This has given rise to no difficulty and a succession of operators has worked the process successfully after one day's tuition. The change is definite. So long as more lime is required the sullage in the tank has a uniformly cloudy appearance. When the correct pH value has been attained, this appearance changes to that of relatively large particles of floc floating in a perfectly clear medium. If, after stirring in the added lime, the tank is allowed to settle for a few seconds whorls of floc can be seen through the clear medium to a depth of two or three inches. When the tank presents this appearance the end point has been reached and no more lime should be added.

(2) On one occasion lime which had been exposed to wet, and had become discoloured was used. This brought about deterioration of the effluent. The lime used should therefore be in sound condition and the milk of lime freshly prepared.

(3) Occasions have arisen when, following the use of large quantities of soda for cleansing purposes, the alkalinity of the sullage water has been so high that no lime has been required, or the addition of acid has been necessary. This marked variation in reaction has seldom occurred, and only when treating the sullage in relatively small tanks. When large tanks are in use an average is maintained, and the addition of acid has never been found necessary.

Excessive alkalinity is to be suspected when the addition of lime in a quantity greater than that normally required fails to produce a floc. It can be confirmed only by the use of an indicator such as phenolphthalein. Commercial spirit of salt is a cheap and easily procurable form of acid.

The following facts were ascertained before commencing a series of runs with accumulation of sludge :—

(1) The tank, the walls of which were thirty inches high, could be operated most conveniently when filled to a depth of twenty-one inches. This was done on each occasion. The calculated capacity, at this level, was 1,323 gallons.

(2) Adequate sedimentation in a tank of this depth took place in a maximum time of four hours, after which period the time required to effect further improvement, either in the quality of the effluent or the packing down of sludge, was out of all proportion to the improvement in results.

(3) After several runs the accumulated sludge settled more rapidly and



the time of settling could therefore be reduced provided care was taken to avoid drawing off the effluent too early and so giving rise to deterioration in the quality of the effluent.

It is not possible to lay down an optimum time of settling, since this varies with local conditions.

When the greatest purity of effluent is essential the full four hours. The final mixing should be allowed, since the last stages of sedimentation are difficult to detect visually. If the effluent is drawn off as soon as it appears to be clear a poor quality will result.

On the other hand, when purity of effluent is not of first importance, as for instance when the effluent is to be discharged into a stream of relatively large volume, or where purity is not governed by statutory regulations, the time of settling may be reduced to two hours or even to one hour. When this is the case considerable economy in tanks is brought about, since a smaller number may be worked in more rapid rotation.

In the experiments to be described the four hours settling period was adhered to throughout.

(4) As previously stated, accumulation of sludge permits a reduction in the dose of ferrous sulphate with resulting diminution in the bulk of floc. In practice this would permit of increased intervals between sludging.

If the highest degree of purity of effluent is essential reduction in the dose of coagulant must be carefully controlled. As the amount permissible depends to some extent upon the quality of the sullage treated, no rule can be laid down.

If quality of effluent is not of first importance, a substantial reduction in coagulant may be made, and may be controlled simply by the clarity of the effluent in the tank. In one series of runs the original dose of ferrous sulphate necessary to treat kitchen sullage was 30 grains per gallon. After accumulation for six runs this was reduced to 10 grains per gallon

TABLE I.

Depth in inches of sullage in tank before treatment	21	21	21	21	21	21	21	21
Quantity of sullage added (gallons)	1,323	1,109	1,046	990	981	1,062	983	945
Suspended solids in effluent p.p. 100,000	2.4	1.0	1.0	1.0	1.0	1.0	2.0	1.8
Depth in inches after drawing off effluent	Sludge	1.6	2.7	3.8	4.3	4.3	4.4	4.5
	Total	3.4	4.4	5.3	5.6	5.1	5.4	6.0
Gallons remaining	..	214	277	333	352	321	340	378

NOTE.—Owing to irregularities in the bottom of the receptacle, difficulty was experienced in measuring exactly the depth of the sludge. The figures shown represent the average of measurements taken in nine different places, but they are nevertheless liable to error. They may be accepted only as a reasonably close approximation.

and this quantity sufficed for all subsequent treatments with no visible deterioration in the quality of the effluent.

In the experiments to be described reduction of dose was not practised and the original dose of 30 grains per gallon was adhered to throughout.

The procedure after dosing and mixing was therefore to allow the mixture to stand for 30 minutes, then mix a second time, sediment four hours, draw off the effluent and refill, the sludge remaining in the tank. This procedure was followed on each run.

The sullage water was on all occasions the mixed output from the bath-house, ablution room, kitchen and dining hall of the Army School of Hygiene. It may therefore be accepted as representative of the total output from a butted camp provided with a continuous piped water supply.

The results recorded from a series of eight runs are shown in Table I.

#### ACCUMULATION OF SLUDGE.

Accumulation of sludge brought about better results than had been anticipated. The first run, involving the treatment of 1,323 gallons, gave an average depth of sludge of approximately 1·6 inches. After the eighth run, involving the treatment in all of 8,379 gallons, the sludge had increased to 4·6 inches only. The apparent diminution in the proportion of sludge resulting from the later runs may perhaps be accounted for by the fact that the greater the bulk of sludge the more tightly it packs down. It is also possible that accumulation produces a more compact floc since settling appears to take place more rapidly.

In assessing the relative quantities of sludge (1) when the tank is sludged after each run and (2) when accumulation is allowed, the clear supernatant liquid necessarily left on top of the sludge after drawing off the effluent must also be taken into consideration, since this must of necessity be withdrawn and disposed of as sludge.

The relative quantities of sludge requiring disposal, if accumulation is allowed for eight runs, or if sludged after each run, are shown in Table II. In the former case the sludge is concentrated to less than one-third of the volume remaining in the latter case.

TABLE II.

				When sludge is accumulated 8,379 gals.	When sludged after each run 10,604 gals.
Sullage treated	..	..	..		
Sludge	..	..	..	416 gals.	1,712 gals.
Percentage of sludge	..	..	..	4·9 per cent	16·1 per cent

In situations where removal of sullage water by carting is necessary the quantity to be carted, and consequently the expense, would be reduced to approximately one-twentieth by chemical treatment with accumulation of sludge, or to one-sixth if sludged each time.

A further advantage of accumulation lies in the fact that it permits of

the use of chemical treatment on a small scale at cookhouses and other small sullage producing units, since the necessary interval between sludging may be extended to twelve days or more. In camps of short duration, therefore, the sludge need be disposed of only on the termination of the camp.

In considering the maximum number of runs that may economically be performed without sludging, it may be of interest to record that the plant described above was treated no less than forty times involving the disposal of over 30,000 gallons of sullage. At the end there remained in the tank, after syphoning off the supernatant effluent, only 12 inches, or approximately 725 gallons, of sludge.

It is not proposed that sludge should be accumulated to this extent under ordinary circumstances, since septic tank conditions tend to supervene and the effluent deteriorates, but it illustrates in extreme degree the economy in sludge production brought about by the process. It is also of interest to note that, although the sludge from this prolonged run, when led into a shallow pit ten feet square, had an offensive odour, this disappeared completely after the liquid part had soaked away. Two days after lagooning the sludge had solidified into an altogether inoffensive solid bed, the average depth of which was  $1\frac{1}{2}$  in. This 12.5 cubic feet of earthy material represented the only residue from over 30,000 gallons of sullage water.

#### TANKS.

The canvas tank used in the above experiments appeared at first to be the ideal receptacle for the purpose, but after some three months use it had rotted. Although this particular tank was already old and condemned for water work before being used for sullage, its final condition indicated that a new tank would not have survived appreciably longer.

The rotting appeared to be due to the prolonged period of saturation rather than to any specific action of sullage water or chemical coagulant and it may be the case that, if used for only short periods and washed and dried after use, canvas tanks would have a normal life when used for this purpose. They present a great advantage in ease of transport.

The canvas tank has now been replaced by a shallow pit lined and rivetted with wood. This is costly and in loose soil the sides soon bulge inwards, even if strongly constructed. The method cannot therefore be considered satisfactory.

Galvanized steel tanks would undoubtedly prove to be the best receptacles for the purpose, provided transport for them could be arranged. They can be obtained cheaply in standard sizes, would last indefinitely, and could conveniently be fitted with effluent and sludge outlets at the correct levels.

#### EFFLUENT.

The quality of effluent demanded depends upon local circumstances or upon statutory regulations.

A. The general standards recommended by the Sewage Commissioners are as follows :—

(1) No sewage effluent should contain more than three parts of suspended solids per 100,000.

(2) No sewage effluent should absorb more than two parts by weight of dissolved oxygen per 100,000 in five days at 18° C., and the stream, after receiving the effluent, should not absorb more than 0.4 parts under the same conditions.

B. These standards may be relaxed when the stream receiving the effluent exceeds 150 times the volume of the effluent discharged into it. Under these conditions there is no difficulty in obtaining an effluent of the requisite purity.

A. In those situations where the highest standards are demanded, no difficulty should be experienced in complying with them as regards suspended solids, providing the following instructions are adhered to :—

(1) The second mixing, which should be carried out thirty minutes after the addition of lime, must be thorough. It is insufficient merely to stir up the floc. It must be well mixed and stirring must be continued for approximately two minutes before final settling is permitted.

(2) The time of sedimentation, after the second mixing, may not usually be reduced to less than four hours.

As previously stated, the effluent absorbs more than two parts of dissolved oxygen per 100,000. If necessary, a considerable but insufficient degree of oxygenation may be brought about by allowing the effluent to pass over improvized weirs situated in the channel leading to the outfall. Further oxygenation, which brings the effluent well within the highest standard, may be brought about by chlorination. This has been applied in practice as follows :—

A drip can is prepared by making a small hole in the side of a large tin, such as a five-gallon drum, about one inch from the bottom. This hole is fitted with a wooden spigot. The volume of water which will be discharged through this hole in approximately the time taken to draw off the effluent is ascertained by experiment, and the tin is marked at this level. The tin is then placed in such a position that the outflow from it will pour into the effluent as it issues from the tank.

The amount of bleach necessary to supply approximately ten parts per million of chlorine to the quantity of effluent to be drawn off is calculated. A quantity sufficiently in excess of this to compensate roughly for the undelivered portion left below the outlet from the drip can is measured, thoroughly mixed with water, and washed into the drip can. The can is then made up to the mark with water. This should be allowed to settle until all the lime has been deposited to below the outlet hole, as otherwise the lime is liable to interfere with the rate of flow.

When the effluent commences to discharge the spigot is withdrawn from the hole in the drip can and the chlorine solution discharges into the effluent.

The above method, which is very simple to carry out in practice, distributes the chlorine evenly throughout the effluent, and, combined with aeration over two small weirs, has been found to reduce the oxygen absorbed from 8 parts to 1.4 parts per 100,000.

B. When the highest standards of purity are not demanded, the oxygen absorbed factor may be neglected. Under these conditions suspended solids also may be higher provided that trouble from this cause is not anticipated if final disposal is by soakage. Considerable latitude is therefore permissible and the final settling time may be reduced.

Where final disposal of effluent is by soakage, oxygen absorbed is of no importance. Suspended solids, if excessive, will tend to hinder soakage, and for this reason it may be inadvisable to reduce the settling time under these circumstances.

#### THE REMOVAL AND DISPOSAL OF SLUDGE.

Sludge may be removed by any of the following methods :—

(1) *Pumping*.—The standard pump, lift and force, Mark V, was tried, and failed to lift the thick sludge produced by accumulation. A special sludge pump would be necessary.

(2) *Running Off*.—If galvanized steel tanks are used, a special sludge outlet not less than 1½ inches in diameter should be provided.

(3) *Syphoning*.—In the experiments described above the sludge was removed by syphoning into a shallow pit by means of two joined 12 foot lengths of rubber hose pipe provided for use with pump, lift and force, Mark V. These pipes have an internal diameter of 1½ inches and they proved satisfactory for the purpose. They are an Ordnance supply.

(4) *Suction*.—By means of a vacuum tank mounted on a motor chassis. This would undoubtedly be the ideal method, since the sludge may be removed as desired and carted to a distance for final disposal. The expense involved in providing the necessary vehicles would be small, since one vehicle could serve a very large camp or a number of small camps within a comparatively large area.

The sludge, after removal by any of the above methods, may be run into a shallow sump; in moderately porous soil the liquid portion rapidly soaks away and the area of the sump required is therefore small, even if it is to be used repeatedly.

#### CONCLUSIONS.

It would appear that, provided suitable receptacles are made available, the only situations where sullage water could not be completely and satisfactorily disposed of by the methods advanced are :—

(1) From a camp site on clay and with insufficient slope to drain away the effluent. From such a site there would be no possible means of disposing of sullage water, or, as a matter of fact, of rain water, other than by carting it away.

(2) From a camp situated on a clay site with some slope and with

little or no porous soil overlying the clay. In such a situation it would be necessary to lagoon the sludge or to remove it by carting.

Provided that the slope from the treatment area is not towards the camp, there is no more difficulty in disposing of the effluent than in drawing off rain water. In camps where no provision is made in the form of drains for collecting sullage water into one area for treatment, there is no good reason why two tanks of suitable size should not be erected at each sullage-producing point, e.g. bath house, cookhouse, etc., and treatment be carried out locally. Provided that consideration is given to the layout of the sullage-producing units, and a reasonable degree of grouping is achieved, the number of tanks required should not be excessive.

#### SUGGESTIONS FOR GUIDANCE IN THE DESIGN OF PLANTS FOR THE CHEMICAL TREATMENT OF SULLAGE WATER.

##### *A.—General Consideration.*

Concentration of sludge by accumulation in the sedimentation tanks should prove to be of advantage, not only for temporary camps, but also for permanent sullage disposal plants of small or moderate size. It is, therefore, suggested that, in designing all such plants, provision for accumulation of sludge should be made.

The removal of solid waste matter and solidified fat is desirable as a preliminary to chemical treatment. Sullage water which is liable to contain such substances should therefore be passed through a strainer and a cold water grease trap of suitable size and design before entering the sedimentation tank. This matter has already been fully considered. (Mackenzie, 1938.)

The mixing of chemicals in small tanks presents little difficulty and may be performed by means of a wooden paddle. In relatively large tanks leverage is difficult to obtain, and thorough mixing by means of a paddle has been found to be possible only if the operator wears rubber boots and gets inside the tank. The necessity for this may be avoided by the use of a long-handled mixer designed on the lines of a squeegee, but with a deeper blade. If canvas tanks are in use the lower edge of the blade should be fitted with rubber to protect the tank from undue wear. The chemicals, when added, should be distributed all over the tank. Complete mixing can then be brought about by long slow strokes with the mixer from side to side of the tank.

In temporary plants, in which the effluent is to be drawn off by a syphon pipe, the suction end of the pipe is movable and the only point which requires attention is the gradually diminishing capacity of the sedimentation tank which results from accumulation of sludge. This should be taken into consideration when calculating the size or number of tanks which will be required to deal with a known output of sullage.

In all cases in which a fixed effluent outlet is to be fitted to the

sedimentation tank, the situation of this outlet will have to be determined experimentally or calculated theoretically.

Undoubtedly the most satisfactory procedure would be to carry out preliminary experiments on the lines of those previously described. This should be possible in all cases in which it is intended to convert an existing plant.

On the other hand, in the case of new buildings or of movable tanks required for use in a variety of conditions, it will usually be necessary to rely upon a theoretical calculation. In this event the following factors should receive consideration, for upon them will depend the correct position of the outlet for the effluent:—

- (1) The number of runs it is desirable to make before sludging.
- (2) The quality of the sullage to be treated. Upon this depends the dose of coagulant necessary and consequently the proportion of floc to the quantity of sullage treated.
- (3) The size and design of the effluent outlet. Experiments designed to ascertain the influence of size of outlet on sludge disturbance elicited the following facts. The head of water was, on each occasion, 20 inches.

A	B	C
2½ in.	7 min.	3 in.
1½ „	10 „	2½ „
1¼ „	16 „	2 „

A = Internal diameter of pipe (see Note).

B = Approximate time taken to empty 180 gals.

C = Height above sludge level from which effluent may be drawn without disturbance of sludge.

NOTE.—The figure given under A above is the actual internal diameter of the outlet passage. It is understood that the trade defines the outlet pipe by the plug size, and that the plug size is ¼ inch less than the measurement given above. To the trade a 2½-inch outlet therefore takes a 2-inch plug.

- (4) The working depth of the tank. Upon this depends the head of water which influences the velocity at the outlet. This materially affects the disturbance of sludge when drawing off effluent.

It has been found that effluent may be withdrawn, without disturbing the sludge, by a 1½-inch outlet horizontally placed 2 inches clear above sludge level, when the head of water above the draw-off pipe is 20 inches. It is considered that, in practice, this clearance should be increased to 4 inches. This figure allows an ample safety margin to compensate for any increased velocity at the outlet, which may result from an increase in the head of water above the 20 inches used experimentally.

*Example.*—In the experiments described in Table I the depth of sullage water in the tank was 21 inches. The depth of sludge, after 7 runs, was 4.5 inches, or slightly more than one-fifth of the total depth.

In applying these experiments to the design of a permanent plant, involving the use of a tank 4 feet in depth and removal of sludge once weekly, we should allow slightly more than one-fifth of the working depth,

say 9 inches, for accumulation of sludge and a further 4 inches to avoid disturbance of sludge when drawing off the effluent. The effluent outlet should therefore be placed not less than 13 inches from the bottom of the tank.

When dealing with a tank with a sloped bottom the figure for sludge accumulation would naturally be calculated on capacity and not on depth.

### *B.—Movable Tanks.*

These should be oblong in shape and made preferably of galvanized iron or galvanized steel. The most suitable depth is from 2 feet 6 inches to 3 feet.

The correct height for the effluent outlet may be calculated only approximately on the basis outlined above, since these tanks may be required to deal with sullage from single producing units and not with a fairly constant mixed sullage. The product of a kitchen will require more coagulant than will that from a bath-house and the proportion of floc will

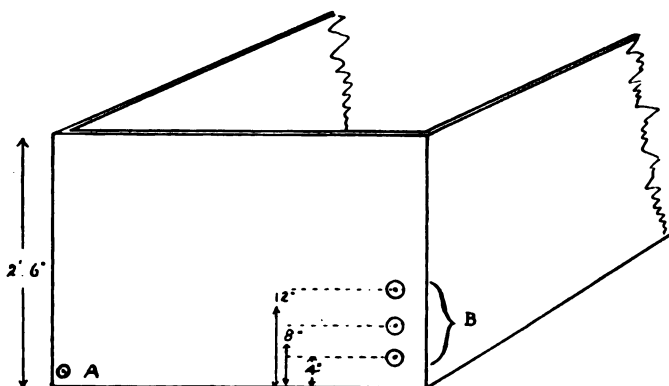


FIG. 2.—A, Sludge outlet. B, Effluent outlets.

therefore be greater. An effluent outlet correctly placed when the tank is used for treating kitchen sullage would therefore be so high as to be uneconomical when the tank is required to deal with ablution waste. For this reason all small galvanized steel tanks should be provided with three effluent outlets situated one above another at approximately 4, 8 and 12 inches from the bottom of the tank. Each outlet should be closed by means of a screw plug operated by a large spanner. The provision of three effluent outlets as described has proved of great advantage in practice, since they permit of a considerable measure of flexibility in the use of tanks.

A sludge outlet of similar design should be situated as near the bottom of the tank as possible (*see fig. 2*).

Effluent and sludge will normally be run off into different drainage channels, and the effluent and sludge outlets should therefore preferably be sited near opposite sides of one end of each tank (*see fig. 2*).



The design recommended above necessitates specially constructed tanks which will not always be available. It should therefore be emphasized that they are suggested only as the ideal arrangement, and that the process can be carried out with equal efficiency, if with less facility, in any receptacle of convenient shape provided a flexible pipe suitable for use as a syphon is available.

When collection of sullage into a central treatment area is possible, large tanks of approximately 1,500 gallons capacity are the most suitable and may be operated in threes, two to receive during hours of heavy sullage output, the third to receive during the hours of smaller output when the other two are settling.

With such a lay-out the collection of effluent and sullage into their respective channels may give rise to some difficulty, since it involves the crossing of channels. This difficulty may be overcome by keeping the effluent channels at a higher level and leading them in pipes over the sludge channels.

Alternatively, the effluent may be syphoned or run off through a pipe of sufficient length to deliver it beyond the sludge channels (*see fig. 3*).

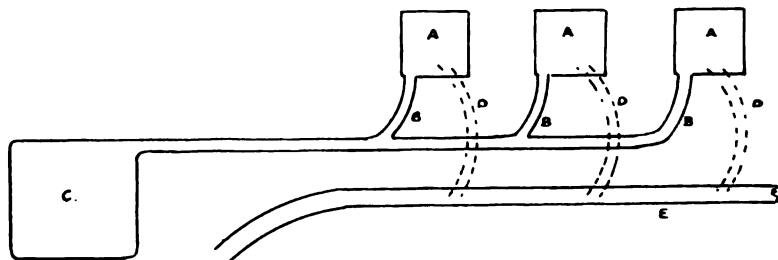


FIG. 3.—A, A, A, Sedimentation tanks. B, B, B, Sunken channels leading from sludge outlet to sludge lagoon (C). D, D, D, Dotted lines represent syphon pipes or drains for removal of effluent to E, Effluent collecting channel.

In cases where it is necessary to sink the sedimentation tanks into the ground it is possible, provided a moderate slope exists, to run off the effluent into a channel (*see fig. 1*). The removal of sludge from a direct outlet is more difficult in these circumstances, and in all such cases it is more easily removed and collected from various tanks by means of a syphon pipe.

The situation may be summarized by saying that, in those situations where a considerable slope exists, no difficulties of disposing of both sludge and effluent should arise, and where the slope is moderate or slight any difficulties which may arise can easily be overcome by the exercise of a moderate degree of ingenuity. It is obvious that, where no natural slope exists, drainage cannot take place unless a slope is provided by digging a drain of gradually increasing depth. This can be of service only when a fall in ground level is available at a reasonable distance to enable the drain to reach the surface. In the absence of any fall within a short distance, disposal by soakage is the only alternative. As has been pointed out

previously, where there is no slope and no soakage, as on a flat clay site, sullage water can be disposed of only by carting.

When collection of sullage into one area is not possible, small treatment tanks will be required at each sullage producing unit, e.g. cookhouse, bath-house, ablution bench, etc. These tanks would normally be arranged in pairs.

As before, the effluent and sludge pipes should be sited on opposite sides of tanks and the arrangement should be reversed on alternate tanks to enable them to be used in pairs as shown in fig. 4. This arrangement

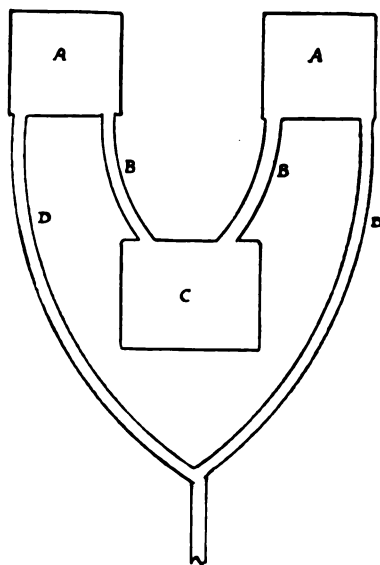


FIG. 4.—A, A, Sedimentation tanks. B, B, Sludge pipes. C, Sludge lagoon.  
D, D, Effluent pipes.

would in no way militate against the use of the same tanks arranged as shown in fig. 3, when required.

### *C.—Permanent Plants.*

An apparatus for the chemical treatment of sullage water from barracks by continuous flow sedimentation has been devised by Thompson (1937), and quiescent sedimentation only will be considered in the following paragraphs :—

Certain advantages accrue from the use of deep settling tanks of the Dortmund type, but these advantages are more than offset by the following disadvantages :

- I. The greater depth necessitates a longer quiescent period for settling.
- II. Serious loss of head results from their use.

Unless the sullage is lifted mechanically their use is therefore restricted to situations where a great fall exists naturally.

For the above reasons shallow tanks will usually be preferred. The tanks should be in duplicate or triplicate and oblong in shape, with one end deeper than the other. If the natural slope of the site permits the resultant increase in depth, the floor should be laid with a slope of about 1 in 10 from the shallow to the deep end and from the sides towards a central channel to facilitate sludging. The surface should be rendered with good smooth cement and angles should be rounded.

The capacity of any one tank should advisably not exceed 2,000 gallons. Where the quantity of sullage water to be dealt with is large, several small tanks worked in rotation are to be preferred to a smaller number of large tanks and the advisability of providing one smaller tank to receive during the hours of light output may be considered.

In considering the maximum size of tank which is desirable, it should be emphasized that the methods advanced are intended to fill the gap between the disposal of small quantities of sullage water by means of grease traps and soakage pits, and a sewage works. They are in no way intended as substitutes for the latter. This could not be the case since the process is incapable of dealing with faecal matter and if tanks are constructed beyond a strictly limited size, difficulty in dosing and mixing the chemicals will arise, which can be overcome only by mechanical means.

The provision of multiple outlets for the effluent from permanent concrete tanks is considered undesirable because the valves are mechanically operated. Considerable complication and added expense would therefore result.

The best type of valve for the effluent and sludge outlet pipes is a matter which requires consideration. It has been found that a hand-lifting penstock is unsuitable since accurate closing of the watertight face is prevented by the deposition of lime on the seating. It is probable that a disc valve would be self-cleansing, and if fitted with cam relief motion this type should prove suitable.

It has been found that if the valve mechanism is inside the tank sludge tends to settle on the valve and is discharged with the first flow of effluent. The valve and operating spindle should therefore be situated outside the tank, the outlet leading to the valve from the tank being as short as possible and the intake splayed sufficiently to prevent sludge from gaining lodgment on it.

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## THE DIFFERENTIAL DIAGNOSIS OF PROLONGED PYREXIA IN INDIA.

By MAJOR R. A. BENNETT,  
*Royal Army Medical Corps.*

IN the medical wards of a military hospital in India there are many difficult problems to harass the medical officer in charge, and one of the most difficult and worrying is the diagnosis of a case of prolonged pyrexia. There is nothing more disheartening than to watch one of these cases from day to day, while, even after enlisting all the aids, both clinical and laboratory, at one's command, the diagnosis remains elusive. I feel, therefore, that it might be of some help to young officers who are about to commence a tour of duty in India if I attempt, in this short article, to describe some points which might help in the differential diagnosis of these "fevers." I shall deal only with cases in which the pyrexia exceeds seven days, and in which there is no obvious cause, such as a large subcutaneous abscess, or lobar pneumonia.

In the investigation of these fevers, a very careful clinical examination is the first essential. There are so many cases in which physical signs are few, or absent, that examination is apt to become perfunctory, and some vital point is missed. After a careful examination, the blood is examined for parasites; blood cultures, Widal's and blood counts are made, and the patient is sent for X-ray examination, if this is considered necessary.

The total and differential white blood counts must be done accurately if they are going to be of any help. It is far better to do without this aid to diagnosis, if the result cannot be depended upon. An inaccurate result may mean a wrong diagnosis. The normal total white count varies between 6,000 and 9,000 cells per cubic millimetre, and the average differential count is: Polynuclear leucocytes 64 to 68 per cent; lymphocytes (large and small) 30 to 34 per cent; large mononuclears 2 to 4 per cent; eosinophils 1 per cent.

In any "fever" occurring in India malaria is the first disease to exclude, and blood smears are examined from day to day. If these, after careful examination, show no malaria parasites, and the patient has taken no antimalaria drug, then, in the great majority of cases, the disease is not malaria. There is one exception to this.

A malignant tertian infection may cause a continued fever with no obvious intermittent paroxysms, and the parasite may be very difficult to find. The spleen is enlarged, the patient complains of continuous headache, and the clinical picture closely resembles an enteric group infection. The following points may be of some assistance in diagnosing these cases.

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The cases usually occur during the second half of the malaria season, when malignant tertian infections are prevalent, and there may be associated cases, in whose blood the parasite has been found. If they are watched carefully and questioned about their symptoms, it will commonly be found that the headache increases in severity towards the end of the morning, or in the afternoon, and there may be a very slight rigor. Eventually, after a number of examinations, the small ring form of the malignant tertian parasite is found in the blood smear, and the diagnosis is established. The spleen is not palpable in every case of malaria, and this applies especially to the primary attacks.

There is one fairly common condition which sometimes resembles malaria, and now and again cases are diagnosed as clinical malaria. This is a *Bacillus coli* infection, which may occur in paroxysms resembling malaria rigors, or as a continued pyrexia.

There may be no symptoms referable to the urinary tract, and the urine may show nothing abnormal on microscopical examination, but if a catheter specimen is sent for culture a pure growth of *B. coli* is isolated. It is difficult to isolate this organism from the blood. This disease is not uncommon in young soldiers, and should be kept in mind when other examinations are negative.

**Relapsing fever and rat bite fever** are two conditions which are usually treated as malaria, until their respective organisms are discovered. These diseases are not commonly met with in Army practice in India, but in a case which defeats diagnosis they must be kept in mind.

**Relapsing fever**, as its name implies, occurs in paroxysms, with apyrexial intervals, and the number of relapses varies. There are no characteristic signs or symptoms, but if the blood is carefully examined the *Treponema recurrentis* will be found.

In **rat bite fever** the symptoms are somewhat similar, but there is usually the history of a rat bite, and the old wound flares up with each paroxysm, while the lymphatic glands draining the area become inflamed and enlarged. The *Spirillum minus* is difficult to find in the peripheral blood, which should be inoculated into white rats or mice.

**Enteric group infection** is the next problem in diagnosis and this may prove a very difficult one.

The textbook picture of typhoid fever, with the step-ladder rise in temperature, the enlarged spleen, the typical rash, the tympanitic abdomen and "pea soup" stools is not commonly seen nowadays in an inoculated community like the Army. Most of the cases are mild, although the pyrexia may be prolonged.

Here is a description of the average case as seen in the medical wards of a military hospital. The patient is admitted complaining of headache, with pains in the limbs and back, and there may be a slight cough. He feels ill, but does not look very toxic. The tongue is furred, constipation is usually present, the temperature is about 101° F. and the pulse rate

is about 80 per minute. The temperature rises steadily in the first few days, and usually remains above the 101° F. degree mark, sometimes approaching 104° to 105° F. until it drops by lysis, in some cases, after ten days, but usually in from two to three weeks. The pulse-rate remains fairly steady, unless complications set in. Rigors are uncommon. The spleen becomes palpable on the third or fourth day, and this may be the only objective sign throughout the course of the disease. The headache usually disappears between the seventh and tenth day, and although the temperature remains high, the patient may look and feel well. The white count shows a slight leucopenia with a relative lymphocytosis, but this is not constant. The medical officer, who has had no experience of these cases, despairs of making a clinical diagnosis, but feels hopeful that the laboratory will come to his aid. Unfortunately the laboratory sometimes fails him in these cases.

Blood, fæces, and urine are sent repeatedly for culture, with negative results. The last hope of making a positive diagnosis is by a rising Widal, but in a number of cases the result is disappointing.

Here are the Widal results of two cases: the first, typhoid fever, and the second, paratyphoid, in which the diagnosis was confirmed by positive blood and stool culture. In the first case *B. typhosus* was isolated from the blood on June 21, 1937, and the Widal results were :—

			24.6.37	2.7.37	10.7.37	17.7.37	26.7.37
T.H.	..	..	110	1,100	5,500	100,000	200,000
A.H.	..	..	50	25	25	22	22
B.H.	..	..	45	25	22	40	40
T.O.	..	..	125	500	700	500	250

In the second case *B. paratyphosus A.* was isolated from the blood on June 20, 1937, and the Widal in this case are a striking contrast to the first.

			24.6.37	2.7.37	9.7.37	16.7.37	23.7.37
T.H.	..	..	50	50	35	50	85
A.H.	..	..	17	0	0	0	0
B.H.	..	..	125	55	35	50	50
T.O.	..	..	25	25	25	0	25

The following is the type of Widal from which the diagnosis is usually made. In this case *B. typhosus* was isolated from the blood.

			7.5.37	12.5.37	19.5.37	26.5.37	2.6.37
T.H.	..	..	27	135	1,000	1,000	550
A.H.	..	..	17	50	50	100	65
B.H.	..	..	17	35	50	45	27
T.O.	..	..	250	175	250	250	500

The case with a relative absence of specific agglutinins, quoted above, is not an isolated one, so one has to be prepared to make a diagnosis on clinical grounds alone, and ignore the findings from the laboratory. A clinical diagnosis of enteric group infection should never be made without repeated and thorough examinations of the case, and a careful consideration

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of alternative diagnoses. The following points may help in differentiating this infection from other diseases which may closely resemble it.

**Tropical Typhus** is the first. I can only speak with experience of the type found in the Simla Hills, and this is very like an enteric group infection. Tropical typhus is a "place" disease, that is, it is endemic only in certain localities, and this is a useful point in the differential diagnosis. Clinically, a severe case of typhus looks more ill and prostrated than a severe case of enteric fever, and bronchopneumonia is commoner in the former disease. The suffused eyes and congested appearance of the face, which are characteristic of typhus, are only seen in the severe forms, while the typical rash occurs only in certain types of the disease. In the milder forms the diagnosis will have to be made by a positive Weil-Felix reaction, but when T.A.B. agglutinins rise in sympathy the picture becomes rather complicated, and the final diagnosis may be in the nature of a guess, rather than by scientific deduction.

**Undulant or abortus fever**, although not very common in India, has to be considered in the differential diagnosis. This disease is difficult to diagnose clinically in the early stage, but in the later stages it presents a fairly characteristic clinical picture, and resembles rheumatic fever rather than an enteric group infection. The patient does not usually look or feel ill, but the tongue is covered with a whitish fur, and obstinate constipation is the rule. The spleen is slightly palpable, and the pains in the joints and muscles, with the undulating type of temperature chart, lead one to suspect undulant fever, which is confirmed by the positive agglutination test. In every case of undiagnosed continued "fever" it is wise to have the serum tested for these agglutinins.

**Amoebic hepatitis**, leading to hepatic abscess, is the next condition to be considered, and it is a very important one, as a wrong diagnosis may be fatal to the patient. It must first be strongly emphasized that an attack of amoebic dysentery is not an essential preliminary to the above disease. In the cases I have seen, a previous history of dysentery has been the exception rather than the rule. Hepatitis and liver abscess are not complications of amoebic dysentery, but are pathological conditions caused by the *Entamoeba histolytica* finding its way to the liver from the intestine. The mild case of amoebic hepatitis is fairly easy to diagnose, and if there is any doubt about the ætiology of the hepatitis, the therapeutic test—a course of injections of emetine—soon solves the problem. The patient complains of pain and discomfort under the right costal margin, and there is a low remittent fever. On examination, the liver is found to be palpable and tender, and in a mild case, this is usually the only sign of the disease. The stools should be searched for the vegetative or cystic forms of *E. histolytica*, but a negative result is of no consequence, and a course of emetine injections should always be given to these cases. The diagnosis of acute amoebic hepatitis, with abscess formation, may be a much more difficult problem, and a mistake will be very serious for the patient. Acute

symptoms may appear suddenly in a previously healthy individual, and simulate those of typhoid fever very closely. The following case illustrates the difficulty in diagnosis, and also the importance of a thorough examination: The patient, a sergeant, was admitted to hospital complaining of a severe headache, backache, and abdominal discomfort. He had been quite fit up to the day of admission, and there was nothing relevant in his previous history. The temperature became high and continuous, a cough with muco-purulent sputum developed, and the patient looked very ill and toxic. The abdomen became distended and very tender, and there were signs of bronchopneumonia at the base of the right lung. His condition quickly became very serious, and the whole picture closely resembled a severe typhoid fever. The white blood count at that time was about 6,000 per cubic millimetre with a normal differential count.

It became very difficult to examine the abdomen owing to the severe pain, but careful palpation revealed that the distension was due to an enormously enlarged liver which was extremely tender. Later, a pleural effusion developed on the right side, and the blood showed a polynuclear leucocytosis. A course of emetine injections was given, and the patient's condition slowly improved. An abscess was aspirated from the right lobe of the liver, the fluid in the pleura was drawn away, and the patient made an excellent recovery. A case like this points a moral: "If there is any doubt, give emetine." In these acute cases there are always signs at the base of the right lung, perhaps only a few crepitations, but more usually signs of bronchopneumonia or a pleural effusion. The patient has a peculiar sallow appearance which is characteristic of hepatic abscess.

Pain in the right shoulder is by no means a constant sign, and the white blood count, in the early stage, cannot be relied on. An X-ray examination of the liver and right diaphragm is of great assistance, but in some cases the patient's condition does not permit this.

**Perinephritis and perinephric abscess** are diseases which, in the early stages, may simulate an enteric group infection, and, in the later stages, if right-sided, a liver abscess.

This condition is fairly easily diagnosed if there has been a previous pyelitis pointing to an infection of the kidney, but in the blood-borne infections with no urinary signs, the cause of the fever may be very obscure. In the majority of cases the patient complains of pain in the renal area, which may, however, be very slight, and there is always tenderness in the affected region. The blood shows a polynuclear leucocytosis, and in the later stages, when the hectic type of temperature and rapid pulse, with rigors and sweats, point to pus formation, the swelling in the renal area clears up the diagnosis.

But these cases are very worrying and not easy to diagnose, and perinephric abscess must always be considered in the investigation of a long-continued unexplained fever.

An early case of **kala-azar** presents a problem in diagnosis. Later on,



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the enlarged spleen and liver, the positive Fermo-gel test and the marked leucopenia lead one to suspect the disease, and the diagnosis is established by finding Leishman-Donovan bodies in a smear from the spleen or liver.

Kala-azar is essentially a "place" disease—it is endemic in Assam, Bengal, and along the East Coast of India ; it rarely penetrates further west than Lucknow. It must be remembered, of course, that the disease may remain latent for a long time, and symptoms may appear in a patient living in some other part of India who is really a native of, or has been stationed in, one of the endemic centres.

The temperature is remittent in type, and sometimes shows a double rise in the twenty-four hours. The patient does not usually look or feel ill, his tongue is clean, and his appetite is not affected. The spleen is only slightly enlarged in the early stages, and the blood shows a leucopenia with a relative lymphocytosis. Unfortunately, the Fermo-gel test is not positive during the first three months of the disease, so a diagnosis can only be made by finding the parasites in the smear from either a splenic or liver puncture. In some cases, particularly in those from Madras, the Leishman-Donovan bodies are found in the peripheral blood. Medullary puncture of the tibia by a special trocar may be done, when the Leishman-Donovan bodies may be demonstrated in a smear from the red bone marrow.

In the differential diagnosis of any continued fever, tuberculosis, in its various forms, always plays an important part. In fact, it is often diagnosed too readily. The common pulmonary variety is not easily missed, but the "typhoid" form of acute miliary tuberculosis presents a much more difficult problem and, as its name implies, is apt to be confused with typhoid fever.

In acute miliary tuberculosis the temperature is more intermittent in type, and in some cases the rise occurs in the morning instead of the evening. The pulse is more rapid and cyanosis, with dyspnoea, is more marked. Eventually, focal signs appear, either in the lungs or brain, which make the diagnosis clear.

Early tuberculous disease of bone may be responsible for a long-continued pyrexia, with no obvious physical signs to account for it. In one case, after a continued fever of over six weeks, the patient complained of pain in the left buttock, and an X-ray revealed early tuberculous disease of the left hip-joint. Probably a careful clinical examination might have discovered this earlier, but in the absence of leading symptoms these cases can be very difficult.

Tuberculous disease of internal lymph glands in the abdomen and chest is sometimes responsible for an obscure pyrexia, but eventually the symptoms and signs lead to a radiological examination of these regions, and the cause is discovered.

A small pleural effusion, as the cause of a low remittent form of continued fever, may escape detection if the chest is not carefully examined from day to day. The rarer forms, encysted interlobar and diaphragmatic effusion, cause more difficulty, and a diagnosis may only be made with certainty after a radiological examination of the chest.

It must not be forgotten that an **empyema**, especially the streptococcal variety, may develop insidiously, and may be overlooked if the chest is not repeatedly examined.

Bronchopneumonia and abscess of the lung should not cause much difficulty as the clinical picture of both diseases is fairly obvious.

There are certain forms of septicæmia which cause prolonged pyrexia and in which physical signs may be indeterminate or absent.

**Subacute bacterial endocarditis** is an example, and in the early stages of the disease diagnosis may be very difficult. The two diseases which it resembles most are typhoid fever and miliary tuberculosis.

The temperature is of the irregular remittent type, the spleen is enlarged, and in contrast to the above two diseases, the blood shows a leucocytosis, not a leucopenia. Unfortunately, definite signs in the heart may not be evident at first, and blood culture in the early stages is usually sterile. Arterial emboli are important complications of this disease, and these should be searched for most diligently. They may appear in the form of small petechiæ in the skin, a splenic infarct causing extreme pain, or emboli in the kidney, resulting in either a gross hæmaturia, or merely a few red cells in the urine.

Consequently, it is important to examine the urine daily for signs of these emboli. In the later stages of the disease the characteristic signs appear, and blood culture is usually positive.

**Meningococcal septicæmia** sometimes produces a pyrexia which may be prolonged over three to four weeks, and if meningeal signs are not prominent, or absent, the case is difficult to diagnose. These cases commonly occur during an epidemic of cerebrospinal meningitis, and on the slightest sign of neck rigidity, a lumbar puncture should be done and the fluid examined. The sporadic case may be very obscure. One case was diagnosed as undulant fever, owing to the severe pains in the muscles and joints.

**Streptococcal and staphylococcal septicæmias**, which appear "out of the blue," are very puzzling until the organisms are cultured from the blood. There is usually a marked polynuclear leucocytosis pointing to the presence of pus, and if no pus can be detected anywhere, septicæmia must be suspected. In these cases symptoms and physical signs change from day to day. There may be signs of pleurisy or pneumonia, which disappear quickly to give place to severe abdominal pain and diarrhœa. These rapid changes of signs and symptoms should rouse suspicions of a septicæmia.

There are many other causes of prolonged pyrexia, some very rare, but in most of them the diagnosis is fairly obvious.

**Glandular fever**, in its atypical form, in which there is no marked enlargement of lymphatic glands, and no throat signs, may cause difficulty, until the lymphocytosis, with the presence of abnormal cells, puts one on the right track.

The **Pel-Ebstein** type of fever, associated with Hodgkin's disease may be very obscure if the internal lymph glands are the only ones affected.

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The leukæmias are sometimes responsible for a low continued temperature, but examination of the blood at once points to the cause.

Dental and tonsillar abscesses are mentioned as causes of prolonged pyrexia, but this must be very uncommon.

Finally, there are the few cases which defeat diagnosis and are given that very unsatisfactory label—P. U. O. My opinion is that most of these cases are examples of one of the enteric group of diseases, or of tuberculous infection.

The diagnosis of a case of prolonged pyrexia is often a very fascinating study, comparable to the elucidation of one of these intricate problems of crime detection, and like the latter, the most trivial clue should not be neglected.

I am indebted to Lieutenant-Colonel F. G. A. Smyth, R.A.M.C., Officer Commanding British Military Hospital, Dalhousie, for permission to send this article for publication.

## EXPERIMENTS WITH HUMAN AGGLUTINATING SERA.

By MAJOR C. R. CHRISTIAN,

*Royal Army Medical Corps.*

It is well known that the potency of human serum used for blood grouping frequently deteriorates with considerable rapidity. As a result, volunteers may be wrongly diagnosed as "universal donors," and time may be wasted in cross-matching the bloods of donor and recipient, and mistakes occur if this cross-matching is not carried out.

The object of the following experiments was to study methods of increasing the agglutinating power (or titre) of these sera, and to study what factors are of importance in maintaining this power as long as possible.

The agglutinating power of the serum is the highest dilution which is able to produce visible agglutination of the red cells. It is this agglutination of red cells by an incompatible or "typing" serum which causes the severe reaction in the patient when an incompatible donor is used.

The titre of the serum, however, varies according to the time allowed for agglutination to take place, the temperature, the method of reading the results (whether by naked eye, hand lens, or microscope), and the technique used. As the rate of deterioration of the serum can only be discovered by estimating the titre from time to time, it is obvious that some satisfactory and standard method of titre-estimation must be used in all the experiments.

Two methods were therefore tried out, which will be briefly described :—

### (1) DILUTION TUBE METHOD.

The technique was based upon that used in the estimation of the heterophile antibodies in the blood serum of a patient suffering from glandular fever.

The serum was first inactivated for half an hour at 56°C. to destroy the complement and prevent hæmolysis, and a series of increasing dilutions was made in Wassermann tubes. A 2 per cent suspension of washed red cells in saline was added to each tube, and the tubes were placed in the water bath at 37°C. for one hour and then stored in the cold room overnight. They were then inverted three times and the clumping of the red cells observed. The highest dilution of serum causing naked-eye agglutination of the red cells was taken as the titre (by this method).

### (2) SLIDE METHOD.

Hollow ground glass slides were used and a series of doubling dilutions of the serum made on these in 1 per cent sodium citrate-saline solution.

A 5 per cent suspension of whole blood in 1 per cent citrate-saline was prepared and an equal volume added to the diluted serum on each slide. The mixture was then stirred with a stiff wire immediately, after five minutes, and after twenty-five minutes at room temperature. The macroscopic titre, seen by the unaided eye, was read at five minutes, and the microscopic titre, seen under two-thirds magnification of the microscope was read at thirty minutes. The latter titre was invariably found to be four times as great as the former. In the earlier experiments, controls for false reactions (pseudo-agglutination, etc.) were put up but were later found to be unnecessary.

#### COMPARISON OF METHODS FOR ESTIMATING THE TITRE.

By the dilution tube method, two sera gave titres of 256 and 512 respectively. By the slide method the microscopic titres of the same sera were 64 and 128. It was considered, therefore, that the slide method was sufficiently accurate to be employed in the further experiments to be undertaken, and it has, of course, the advantage of speed. The future titres expressed, therefore, are the microscopic titres by the slide method. Strong agglutination is expressed by the sign +, and weak agglutination by  $\pm$ . It must be remembered, of course, that the agglutinability of red cells varies in different individuals, and therefore the sera used in the experiments (Group 3 or 4) were always tested against my own red cells (Group 2).

#### RAISING THE TITRE.

It is obvious, of course, that the typing sera to be kept in stock should be of as high an initial titre as possible in order to remain efficacious for a longer period, but it is not always easy to procure a high titre serum—particularly a high titre of the rare Group 3 serum—in a limited military population. Some method, therefore, of artificially raising the agglutinating strength of serum is required. The following methods were used :—

(1) *Physical Method.*—A light yellow-brown serum with a titre of 64 was chosen ; 10 cubic centimetres were placed in a narrow sterile test tube, frozen solid and thawed at room temperature four times. As a result of this the serum separated into sharply defined upper and lower layers, a nearly colourless upper two-thirds having a titre of 16 and a dark brown lower third having a titre of 128. The upper two-thirds were removed and discarded.

(2) *Biological Method.*—This is based on the fact that red cells absorb specific agglutinins at room temperature and liberate them at 56° C. Groups 2 cells were added to a Group 3 serum having a titre of 32 and the mixture shaken occasionally for two hours at room temperature. The cells were then removed from the serum by centrifugation and washed in saline. They were afterwards added to a small quantity of saline, shaken, and heated to 56° C. for five minutes in a water bath, and shaken

thoroughly. The mixture was then rapidly centrifuged while hot in a pre-heated and well-padded centrifuge tube, a hot water centrifuge not being available. The supernatant saline was removed while hot, and had a titre of 128.

(3) *Chemical Method.*—This was carried out with a number of different sera. These were first diluted with double their volume of distilled water. The euglobulin, precipitated by adding 16 per cent ammonium sulphate crystals to the diluted sera, was removed by centrifugation or filtration and re-dissolved in 2 per cent salt solution, but did not agglutinate red cells. The pseudoglobulin precipitated by 28 per cent ammonium sulphate, removed by filtration in a water-saturated atmosphere, dried by expression between layers of filter paper, and redissolved in distilled water, gave a high titre of agglutination. The final filtrate containing the serum-albumin, etc., did not agglutinate red cells.

By this method a serum had its titre raised from  $8 +$  to  $64 \pm$ . It was found, however, that all the sera so treated gave a somewhat "cloudy" effect which interfered with the macroscopic and microscopic readings. Further experiments showed that if ammonium sulphate crystals (acid) or sodium chloride crystals (B.P., alkaline) were added to a serum, the titre of this was lowered, although insufficient chemical was added to produce any precipitation in the serum. It was evident that the resulting hypertonicity of the serum rendered it unsuitable, and the same "cloudy" effect as above was noted in every case.

The solutions of pseudoglobulin in distilled water was therefore dialysed in collodion bags suspended in water in order to get rid of the ammonium sulphate. Dialysis was continued for six days at  $15^{\circ}$  to  $18^{\circ}$  C. By this method a solution was obtained giving a fourfold increase of titre over the original serum, and much less "clouding."

#### COMPARISON OF METHODS FOR INCREASING THE TITRE.

The method of concentration recommended is that of freezing and thawing, as less working time is required and there is less risk of contamination.

#### EFFECT OF TEMPERATURE ON SERA.

Sera were kept in the incubator at  $37^{\circ}$  C., at room temperature ( $17^{\circ}$  to  $20^{\circ}$  C.), and in the ice box ( $10^{\circ}$  to  $14^{\circ}$  C.). All were protected from light.

A serum with a titre of 16 was so kept for four months. At the end of this time the titre had dropped to 0 at  $37^{\circ}$  C., but was still 16 at room temperature and in the ice box. A second serum was chosen with a titre of 64. In nine months at room temperature the agglutinating power had dropped from  $64 +$  to  $64 \pm$ , but in four months at  $37^{\circ}$  C. it had fallen to 0. The titre of a third serum fell from  $32 \pm$  to  $16 \pm$  in four months at room temperature and to 0 at  $37^{\circ}$  C. in the same period. As will be seen later the rate of deterioration of the serum titre depends

upon the reaction of the glassware as well as upon the temperature. It is evident that the problem is chiefly one concerning the preservation of sera at high temperatures, such as would occur on active service in tropical countries.

#### EFFECT OF MINERAL ACIDS AND GLYCERINE ON SERA.

The following experiments were carried out at 37° C. Preliminary experiments showed that the keeping power of a serum varied in an irregular manner when samples of it were kept in tubes of different kinds of glass. It was thought that this might be due to varying alkalinity of the glass, and investigation showed that the more alkaline samples of serum (high pH) had the lowest titres. From this it seemed likely that the addition of an acid substance to the serum would improve its keeping power. As glycerine (acid, pH below 6·8) was experimented with at the same time, it will be necessary to consider both glycerine and other acid substances together.

The first essential was of course to standardize some method of measuring the reaction of the sera by estimating the pH value. This was carried out as follows :—

A flask of distilled water containing 10 per cent of 0·01 per cent phenol red solution as indicator was adjusted by the addition of caustic soda solution until it was exactly neutral in reaction, the pH remaining stable at 7·0 when tested daily. Three cubic centimetres of this fluid were placed in a "cordite" glass tube and 4 drops of serum were added from a size "56" dropper. The tube was shaken and the pH read colorimetrically by comparison with the standard tubes.

*Experiment 1.*—The following experiment was then carried out to discover the effect of acid substances and glycerine on the keeping power of a serum. The latter was kept in narrow sealed tubes of the same make and glass, which were prepared for use by boiling in alkali soap, rinsing, soaking in 1 per cent hydrochloric acid for twenty hours, rinsing in distilled water (acid, pH below 6·8), and sterilizing by dry heat. The serum was obtained from blood taken into a plain sterile test tube (not new).

Sample of serum	Initial serum	Controls 1 and 2	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Substance added	—	—	1% sulphuric acid	Acid sodium phosphate	Glycerine	Sodium phosphate	Sodium bicarbonate	Glycerine (alkaline)
Amount of substance added	—	—	10%	Trace	About 60%	Trace	Trace	About 60%
Titre of serum..	128+	Both 8+	32+	16+	32±	0	0	16+
pH of serum ..	7·6	8·0 and 8·1	7·7	6·8	8·0	Above 8·4	Above 8·4	Approx. 8·4

Two samples of the same serum, untreated, were kept as "controls" under the same conditions as the tubes containing serum and the added substance. The nature and amount of the latter are shown in the table on page 34, which also indicates the titre and pH at the end of the experiment with the various samples of this serum. The second column of the table headed "Initial Serum" gives the titre and pH of the serum at the commencement of the experiment. The duration of the experiment was ten weeks at 37° C.

From this experiment it will be seen that the "control" sera became more alkaline on keeping, as shown by the rise of the pH value, and that the titre fell considerably. The addition of acid or acid salt produced a lower pH and a higher titre, while the two alkaline sodium salts produced a higher pH and a lower titre. Glycerine (acid) gave a higher titre, but glycerine made alkaline with a few drops of caustic soda solution was not so satisfactory.

*Experiment 2.*—A second experiment was undertaken with a different serum to confirm the above results. As alkali is presumably given off by the glass, the glass tubes (new) and the bottles (not new, having been used many times previously for media) used in this experiment were prepared as in the previous experiment, but the acid used was raised to 2 per cent. HCl for two days.

The serum was obtained from blood taken into an agar-lined test tube. (In this experiment only three drops of serum were used in the estimation of the pH.) The serum was divided into two portions which were treated as follows:—

(a) The first portion was kept at 37° C. for five weeks in sealed glass tubes. Three "controls" of the same serum, untreated, were kept in the same manner as the treated specimens. The following table, arranged as before, shows the titre and pH of the various specimens of serum at the end of the experiment.

Sample of serum	Initial serum	Controls 1, 2 and 3	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	Sample 7	Sample 8
Substance added	—	—	1% sulphuric acid	1% sulphuric acid	N 1% sulphuric acid	N 1% sulphuric acid	N 1% hydro-chloric acid	Acid sodium phosphate	Glycerine	Glycerine
Amount of substance added	—	—	10%	20%	10%	20%	20%	Trace	About 60%	About 80%
Titre of serum	32	All 0	8	4	0	4	8	4	4	2
pH of serum	7.8	All above 8.4	8.0	Below 6.8	Above 8.4	8.4	7.7	6.8	8.3	8.2



(b) The second portion of serum was kept at 37° C. for seven and a half weeks in the screw-capped bottles. Two "controls" of the same serum, untreated, were kept under the same conditions. The following table shows the titre and pH as before at the end of the experiment.

Sample of serum	Initial serum	Controls 1 and 2	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Substance added	—	—	1% sulphuric acid	N/10 sulphuric acid	Acid sodium phosphate	Glycerine	Glycerine	Glycerine
Amount of substance added	—	—	10%	10%	Trace	About 33%	About 60%	About 80%
Titre of serum..	32 +	Both 2 ±	8	4	4	0	2 ±	0
pH of serum ..	7·8	Both 8·2	7·4	8·1	Below 6·8	8·1	8·0	8·0

The two controls gave titres of 8 + and 8 ± when tested at the end of five and a half weeks. At this period the other bottles did not show any improvement over these figures.

*Experiment 3.*—A final test was carried out with a third serum on the same lines as the two previous experiments. In this case more energetic measures were taken to neutralize the glassware. This was boiled in 6 per cent sulphuric acid and potassium bichromate solution for three hours, instead of alkali-soap, soaked in distilled water (acid, pH below 6·8) overnight, and sterilized by dry heat. Four of these tubes were then tested by keeping in them for a week at room temperature some of the neutral fluid (pH 7·0) used in estimating the pH. At the end of the week this fluid was still neutral or only very slightly alkaline (pH 7·0 to 7·1).

The samples of this serum were kept for seven weeks at 37° C. and then the pH and titre of these (including three "controls") were measured. The samples containing 7 per cent of 1 per cent sulphuric acid, and 14 per cent of N/10 sulphuric acid, both gave titres of 32, as against 16 in two of the controls and 8 in the third control; and pH values of 7·8 and 8·0 respectively against 8·2 to 8·3 in the controls. The initial serum, from an agar-lined tube, had a pH value of 7·7 and a titre of 64. Presumably a definite amount of alkali was given off from the glass in seven weeks at 37° C. and the beneficial effect of mineral acid was again evident.

In the course of these experiments the following observations were made:—

(a) *Phenol Red.*—The addition of 14 per cent of 0·01 per cent phenol red solution as indicator to a serum was not found to have any deteriorating effect, and the further addition of sulphuric acid to the mixture improved the keeping power of the serum as compared with untreated serum controls. This fact might be used, sufficient acid being added to produce a standard colour in the serum.

(b) *Reaction of Serum from Clots.*—As the reaction of serum is evidently of importance in regard to its keeping power, the following observation may be of importance in standardizing any method of obtaining serum. All the serum was removed from a blood-clot in an agar-lined tube after twenty-four hours and gave a pH value of 7.8. After four days the serum further exuded gave a pH of 7.4. Another serum, stored in a plain glass tube over a small sediment of red cells gave a pH which fell from 7.5 to 7.2 in three days. Neutral fluid stored in control tubes of the same batch showed no alteration of pH.

(c) *Effect of Salts on Sera.*—The addition of 6 per cent ammonium sulphate to a serum had no effect. About 10 to 12 per cent ammonium sulphate crystals dissolved in a serum had no effect upon its microscopic titre (16) but reduced the macroscopic titre from 4 to 2. In another case approximately 14 per cent ammonium sulphate caused no trace of turbidity in a serum but reduced the (microscopic) titre from 8 to 4. A fourth serum diluted with equal volumes of either normal, half saturated or saturated sodium chloride solution gave titres of 8, 4 and  $4 \pm$ . Although, therefore, the protein was not precipitated from the sera by any of the above hypertonic solutions, the effect was to lower the titre and cause a "cloudy" type of agglutination. These facts indicate the importance of dialysing the pseudoglobulin solution.

(d) *Experiments with Dried Sera.*—These experiments were not completed owing to change of station, but the following results may be of some interest. Two sera were frozen in the refrigerator and then evaporated to a dry powder *in vacuo* at  $-10^{\circ}\text{C}$ . Samples of each were immediately redissolved in sufficient distilled water to restore the original volume, and in both cases the titre had fallen to one-half. Neither of the dried sera when subsequently stored at room temperature or in the ice chest showed any advantage over liquid "control" sera similarly kept; a saturated solution in distilled water gave the same titre as the "controls" and of course a smaller volume. Dried sera kept at  $37^{\circ}\text{C}$ . would not yield a satisfactory solution. It must be noted, however, that these dried sera were not stored *in vacuo*.

(e) *Other Experiments.*—Other methods were tried in which the oxygen dissolved in liquid serum was as far as possible removed or absorbed. This was achieved by (1) addition of glucose; (2) exhausting the air by suction pump for twenty minutes (trial tubes when broken under water showed an almost complete vacuum); (3) removal of oxygen by pyrogallate; (4) a combination of glucose and either of the other two methods. None of these methods improved the keeping power of the sera.

#### DISCUSSION.

In all the foregoing and other experiments it was shown that the sera became more alkaline when stored at  $37^{\circ}\text{C}$ . or at room temperature, in spite of the various efforts made to use neutral glassware. Associated with this

was a marked fall of titre. When mineral acid or acid salt was added to the serum, this was less alkaline or slightly acid (pH lower) and the titre of the serum was definitely higher. The serum also kept much better, and became less alkaline in the old bottles than in the new glass tubes. It was found that excess of acid or acid salt producing a pH well below 6·8 was inimical to the maintenance of a high titre in the serum, and that alkalies producing a pH above 8·4 had the same effect. Glycerine was not found to be wholly satisfactory as a preserving agent. Although 60 to 80 per cent of glycerine added to sera improved their keeping qualities, in no case were the titres obtained so high as when 1 per cent sulphuric acid was used, and a more serious objection was that the type of agglutination was "cloudy" and therefore more difficult to read. In the case of acids and traces of acid salt, however, the agglutination was always quite distinct. Smaller amounts of glycerine had neither good nor bad effect on the sera.

#### CONCLUSIONS.

(1) A method of raising the titre of human agglutinating serum is described.

(2) The importance of the reaction of agglutinating serum in regard to its keeping quality is also shown, together with the improvement obtained by the use of mineral acid.

I should like to express my thanks to Brevet Colonel L. T. Poole, D.S.O., M.C., K.H.P., R.A.M.C., for his advice and the interest he has taken in these experiments. I am, however, responsible for the results.

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## GUILTY BUT INSANE.

By MAJOR G. W. WILL, O.B.E.

*Royal Army Medical Corps.*

It occasionally happens that a Defence of Insanity, or unsoundness of mind, is put forward at a trial by Court Martial. In civil courts this plea is seldom raised apart from capital charges, as counsel usually advise against it. If a verdict of "guilty but insane" is found in such a case it usually means admission to a mental hospital for an indefinite period, while, on a minor charge, the accused would undoubtedly prefer a definite period of imprisonment. Recently this plea has been raised in Courts Martial as a defence to such charges as "shooting with intent," "wilfully maiming," and even in less serious cases.

The following notes may be of some use to medical officers who find themselves unexpectedly confronted with a combination of delinquency and mental abnormality.

Where it seems obvious that the accused is of unsound mind the usual procedure is to have him sent for observation in a military hospital where he is seen by a specialist in mental diseases. If he is found to be of unsound mind he is invalided and the charges against him are dropped. This happens in a large number of cases, especially where the offences are not of a very serious nature. The advantages of such a course are obvious, but where the offence is a serious one it may be considered advisable that the case should proceed to trial. When this happens the first thing that the medical officer has to decide is the man's fitness to appear before a Court. This has reference, as a rule, to his physical condition alone and only in rare cases to his mental state. If he is physically ill he cannot appear and it might not be expedient to allow a case of acute mania to appear before a Court. Another question that may arise is the man's fitness to plead, which is quite a different matter. This question of unfitness to plead by reason of unsoundness of mind is raised after the Court is constituted. Medical evidence may be called at this stage and the Court would consider the following points. Is the accused able to: (a) Understand the nature of the charge against him? (b) Distinguish guilty from not guilty? (c) Instruct his counsel or defending officer? (d) Able to appreciate witnesses? (e) Able to understand what is going on at the trial? The procedure when a man is found unfit to plead is described later. If it is decided that he is fit to plead the trial proceeds.

Medical evidence as to the man's state of mind at the time of committing the offence will be called by the defence. In English law an accused person is considered to be sane until proved to be insane. The burden of proof,

therefore, rests on the defence. The medical witness is first examined by the counsel for the defence, cross-examined by the prosecution, and perhaps re-examined by the defence to clear up any doubtful points that may have arisen in the cross-examination. The writer has been produced as a court witness and examined by the Judge-Advocate, and then cross-examined by the defence, but this is unusual. It is in some ways preferable as it emphasizes that expert medical evidence is expected to be absolutely impartial.

The Court has to decide the state of the man's mind at the time of committing the offence. It is possible that he may have recovered by the time of the trial. Insanity is defined as "a labouring under such unsoundness of mind as to make him incapable of appreciating the nature and quality of the act he is doing or that such an act is wrong." The Court is concerned with the particular act on which the charge is based and medical evidence should be such as to enable them to form a clear and definite opinion as to the man's responsibility for that act. The state of his mind at the time of the trial is not strictly relevant but it may be such as to assist in forming an opinion as to his probable state of mind at the time he committed the offence. For example, a case of general paralysis of the insane who is insane at the time of his trial has probably been in a similar condition for some time. Conversely, an epileptic who is of sound mind at his trial may not have been so when he committed the offence. The Court must be satisfied that the accused has: (a) defective powers of reasoning, (b) disease of the mind, and that, (c) if he did know what he was doing he did not know it was wrong. The late Lord Reading, when Lord Chief Justice, gave judgment at the Court of Criminal Appeal in *Rex v. Codere* stating that the phrase "nature and quality of the act" meant the physical character of the act and not its moral quality and that "wrong" meant no more than that the act was punishable by law.

It occasionally happens that only one medical witness is called. It is highly desirable that two, at least, should give evidence. Medical evidence is largely a matter of opinion based on the consideration of certain facts and a very grave responsibility is placed, not only on the shoulders of a single medical witness, but also on the shoulders of the Court who accept the evidence.

Remember that when you are giving evidence it is given in the form of question and answer and you do not make a statement or deliver a lecture. You may refer to notes made at the time of examining a patient but you may not read your evidence. Before giving evidence see the accused more than once and be careful to include a thorough physical examination. Counsel may question you as to the presence of impacted wisdom teeth or some other condition and its bearing upon the man's mental state. It may be suggested that because you have not done an examination of the cerebrospinal fluid you are expressing an opinion upon insufficient data. Remember to speak solely in reference to established medical facts and avoid theorizing. It is sometimes necessary for the

medical expert to correlate the evidences of mental disorder with facts which may be established by witnesses. The medical witness may under some circumstances be present in Court during the trial to hear the evidence as to facts before giving his own evidence. Counsel may then say, "You have heard the evidence given by these witnesses. Does such behaviour commonly show unsoundness of mind and does such unsoundness of mind usually render persons incapable of knowing the nature of their acts or of knowing that what they do is wrong?" The writer has had the complete summary of evidence in a case submitted to him by a Deputy Judge-Advocate General before a case came to trial.

At the conclusion of the trial the Court may find that the accused is guilty but was insane, or of unsound mind, at the time of committing the offence. In this instance a special finding is brought in and the man is kept in custody in the prescribed manner until the directions of His Majesty thereon are known. A similar procedure is carried out in the case of the finding, "By reason of his insanity unable to take his trial", but should he recover the man may be brought to trial at a later date. It is very unlikely that this would be done in practice.

The usual procedure is that the man is admitted to a military hospital for observation while the case is submitted to the King. In the cases that have come under the writer's notice His Majesty has directed that the man be brought before a Medical Board and disposed of in accordance with the recommendations of that Board.

It must be remembered at this stage that a Court Martial is a legally-constituted Court whose finding of "Guilty but Insane" is a legal finding and that, therefore, the man concerned was legally insane at the time he committed the offence in question. There is no getting away from that. If he be still insane at the time the Board is held he is disposed of as an ordinary mental case. If the Board finds that he has recovered he can be disposed of as a mental case (recovered) under the provisions of Regs., M.S.A., para. 527 (1). Remember that a copy of the promulgation of his sentence embodying the finding of the Court should be attached to the Board proceedings as that may be the only evidence of his insanity at that date.

As a guide to the completion of answers to certain questions in A.F.B. 179 the following example is given. This is adapted from an actual case. Q. 20.—He was in close arrest awaiting trial by Court Martial from ..... He was tried by Court Martial at Dustypur on.....

The charges were : 1st charge : Committing a civil offence, that is to say, attempted murder.

2nd charge : Committing a civil offence, that is to say, shooting with intent.

3rd charge : An act to the prejudice of good order and military discipline.

Finding : Not guilty of the 1st and 3rd charges, but did the act which was the subject of the 2nd charge, but was insane at the time when he did the same.

(Certified true extract from unit orders.)

He was kept in regimental custody until..... when he was admitted to a B.M.H., under orders from the A.G. in India, and transferred to the mental section of a B.M.H. on..... Instructions were subsequently received that he was to be brought before a medical board.

His previous medical history is then stated.

Q. 21 is filled up according to circumstances. There may be a clear-cut cause for the mental break-down.

Q. 23.—A description of the man's present condition is given.

Q. 28.—The Board may state that they have seen a copy of Part II, orders of the unit, to the effect that Private so-and-so was insane, etc., and that this legal finding is equivalent to a diagnosis of insanity. If he is considered to have recovered it is so stated.

If a man be found "Guilty but Insane" on a capital charge it is possible that he might be committed, on His Majesty's directions, to the State Criminal Mental Hospital at Broadmoor, but the writer does not know of any precedent for this.

It is important to realize that in all cases where a soldier is found insane by a Court Martial his disposal is according to the instructions of His Majesty the King.

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## Editorial.

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### REPORT OF THE MEDICAL RESEARCH COUNCIL FOR THE YEAR 1936-37.

A GRANT-IN-AID of £195,000 for the year 1936-37 was provided by Parliament for the expenditure of the Medical Research Council during the financial year. This was greater by £36,000 than the year before, the difference representing special provision made for the development of research work in chemotherapy. This work will require the income from the first twelve months for expenditure on buildings and equipment before actual investigation can be undertaken.

The discovery and production of medical compounds of value for the treatment of disease in men and animals have depended almost entirely on German science and industry.

Notable discoveries in chemotherapy have been made in this country. Thomas and Breinl, in 1904, first demonstrated the trypanocidal action of atoxyl. Plimmer and Thompson, in 1907, discovered the trypanocidal action of tartar emetic, and the value of this drug in bilharziosis was established by British workers. The original discoveries initiated intensive researches for compounds superior to the original substances, but this work was mainly carried out abroad, and hence these branches of therapy passed into foreign hands. Foreign firms have built up large organizations and have spent large sums of money to advance this aspect of therapeutics. They take out comprehensive patents to cover their chemical agents, but they do not as a rule grant licences for their manufacture in England; in case of war the British Empire might be deprived of essential drugs, as occurred in the case of salvarsan compounds in 1914.

The scientific problem in chemotherapy is of special nature. The aim is to find substances which are lethal for particular parasites, but not seriously toxic for the human subject. The difficulty in the way of finding such substances is the apparent absence of any rational connexion between chemical structure and therapeutic value. The search is therefore largely empirical involving the production and testing of an infinite number of different substances.

In Germany, where research in chemotherapy has been so successful, investigations have been made in the large research establishments maintained by the manufacturing firms. Manufacturing chemists in Great Britain have been unwilling to use their resources in this manner, and the only possibility of securing that this country takes its proper place in relation to its Imperial responsibilities is a national scheme supported by public funds.

In the absence of effective co-operation by industry, it was considered



that a central research laboratory with a staff able to give their whole time to chemotherapy would be an essential factor in a national scheme. It was proposed, nevertheless, that parts of the work should be allocated to different academic centres. The chief advantage of a central laboratory would be close daily association of biological investigators with those engaged in the synthetic production of new compounds.

In a previous Editorial we referred to chemotherapy with sulphanilamide in puerperal disease and the curative effects of this drug in acute and chronic gonorrhœa in both sexes. The curative action of the new therapeutic agents, as shown by Dr. W. Snodgrass and Dr. T. Anderson at Glasgow, has revolutionized the treatment of erysipelas. In streptococcus meningitis their effect has been spectacular. The treatment of *Bact. coli* infections of the genito-urinary tract has been much improved owing to the introduction of mandelic acid as a curative agent. The sulphanide compounds bid fair to replace the mandelic acid treatment, because they are equally effective and more simply administered.

In the last report of the Council investigations at the National Institute for Medical Research on influenza were described; these had led to the preparation of a vaccine from the lungs of mice infected with the influenza virus, this consisted of a filtrate from infective material inactivated by treatment with formaldehyde. Preliminary trials had shown that the injection of this vaccine into human subjects caused the production of antibodies neutralizing the infective action of the virus.

The outbreak of influenza in December, 1936, gave opportunities for trial in the direction of detection of the virus in influenza patients and the differentiation of epidemic influenza from febrile catarrh. The characteristic virus was obtained in throat-washings from patients during the epidemic. It was also tentatively concluded that the disease caused in man by infection with the influenza virus probably constitutes a recognizable clinical entity differing in symptoms as well as in its epidemiological character from other catarrhal infections of the respiratory tract, which had hitherto been confused with it.

It was hoped to test the inactivated virus by vaccinating a sufficient number of persons in advance of the next epidemic of influenza. Unfortunately, the 1936-37 epidemic arrived when only a beginning had been made with this plan. What was done showed that the vaccination is harmless and that antibodies appear in the blood. Six hundred soldiers were vaccinated in groups during the early stages of the epidemic, each group being matched with an equal number of controls. About one hundred civilians were similarly vaccinated and sufficient vaccine for about three hundred persons was sent to Dr. R. M. Taylor of the Rockefeller Institute at Budapest. The results were inconclusive: but it can be said that vaccination did not give protection in all cases. The lack of success was probably due to differences in type of the influenza virus. In

December, 1936, Magill and Francis demonstrated two types obtained from different epidemics. Andrewes and Wilson Smith have confirmed this observation. Strains from various sources appear to fall into several immunologically distinguishable groups. The original strain, obtained from the 1933 epidemic, used for the preparation of the vaccine is now found to fall into a different group from those that occurred in the 1936-37 epidemic against which it was hoped to give protection.

It is thought that if vaccination is to have the best chance of success in any future epidemic it will be necessary to choose an inoculum made from a virus belonging to the same immunological group as that responsible for the immediate outbreak. Hope that success may be ultimately obtained is encouraged by recent experiments in which Andrewes and Wilson Smith have shown that ferrets can be naturally infected with the virus by merely placing them in contact with those already infected, and that vaccination with the same strain of virus will effectively protect ferrets against such contact infection.

Egg-membrane culture can now be used with great advantage for the study of viruses. Many viruses can be propagated, free from bacteria, on eggs, and suspensions of virus may be easily titrated in this way. With due precautions egg membrane technique gives more precise information than the usual laboratory animals. Burnet and Keogh have used the method for the study of antisera on viruses. The membrane offers exceptional facilities for histological study of the lesions produced by viruses; its structure is so simple that the development of special features of virus disease, such as inclusion bodies, can be easily followed in some detail.

A very interesting possibility emerges from the continued passage of virus on eggs. Dr. Burnet has shown that influenza virus changes its character on prolonged passage from egg to egg, so that while remaining virulent for the egg-membrane it loses its virulence for the ferret and the mouse. Yet the avirulent strain preserves its immunizing properties. If these characteristics can be perpetuated the value of such a strain for the immunization of man is obvious. Caution is considered to be necessary, as the fact that virus has once changed its type shows that it is unstable and reversion to this original type might occur unexpectedly.

Common salt is of great importance in the normal working of the body and the lack of it or its excessive loss from the body may be of serious import. In some tropical countries, where the heat involves great loss of sodium chloride and the amount available for eating is small because of distance from the sea and the absence of salt deposits on land, great mental and bodily distress occurs from this cause.

There are occasions in this country when the normal man may be impressed with the importance of common salt. Owing to the investigations of the late Professor J. S. Haldane it is now recognized that miner's cramp is partly the result of excessive loss of sodium chloride by excessive sweating which accompanies hard manual work in a hot atmosphere.

Miner's cramp can be easily cured by giving salt and abundant fluid to such workers.

The part played by salt in disease has become of great interest and its control in diet is important. In kidney disease when there is œdema of the tissues the patients are fed on low salt diets in order to hasten the dissipation of the fluid. The attacks in Ménière's disease can be reduced in frequency by reducing the salt in the food. On the other hand in Addison's disease increased consumption of salt improves the patient's condition.

In order to get a proper understanding of the action of salt on the tissues a series of investigations has been made by Dr. R. A. McCance, Miss E. M. Widdowson and others at King's College Hospital. These workers produced a state of salt deficiency in normal persons severe enough to reproduce the condition found in disease. By giving the subjects a salt free diet and making them sweat profusely in a hot air chamber it was found that after four to eight days of this treatment they suffered from nausea, lassitude and fatigue, sometimes accompanied by a feeling of breathlessness on the slightest exertion. The symptoms closely resembled those found in Addison's disease and the chemical changes in the blood in the two conditions were very similar.

The main result of the investigations has been to define exactly what effects can be produced by salt deficiency alone. The investigators have been able to locate the particular part of the kidney which is responsible for nitrogen retention, to measure the reduction in the volume of extra-cellular fluids, and to study the change in the composition of secretions.

The method adopted by Dr. McCance and experiments on lower animals with other substances, have led to the discovery of specific functions of great interest, and it may be that in the case of common salt, also, something specific may be disclosed in its action; the effect of diminished salt intake on the kidney, and the curious similarity between the effect of salt deficiency in the body and that accompanying destruction of the suprarenal glands is suggestive.

Recent researches have shown that nicotinic acid must be included in the vitamin group. It has been shown to play a part in the transformation of sugar to alcohol, the growth of micro-organisms and the prevention of a pellagra-like disease in animals.

In 1936 Mr. B. C. J. G. Knight, working at the Middlesex Hospital, showed that nicotinic acid and vitamin A were both essential constituents of a medium for the growth of *Staphylococcus aureus*.

For many years workers on nutrition have been convinced that pellagra is fundamentally of nutritional origin and due to defective diet. In 1917 Chittenden and Underhill produced in dogs by certain diets a condition usually called "black-tongue," which is regarded as similar to pellagra in man. Many researches were made to discover the specific factor concerned, the absence of which causes black-tongue to develop, and the addition of

which to the diet cures the disease. B<sub>1</sub> lactoflavin, and B<sub>6</sub> were tried in turn, but each failed to give the desired result.

In the past few months workers at the University of Wisconsin, U.S.A., announced that they had prepared nicotinic acid amido from liver and that this substance and nicotinic acid itself cured black-tongue in dogs.

In an editorial on the researches carried out at the Lister Institute, we referred to experiments by Sir C. Martin and Miss Chieti on the feeding of pigs on maize and casein and the recovery of the pigs by the addition of yeast extract to the diet. The active principle obtained from the yeast resembles Goldberger's "pellagra preventive," which cured "black-tongue" in dogs caused by a diet of maize. These researchers have now found that pigs which were very sick on the maize and casein diet could be cured by injecting nicotinic acid into them.

It seems likely that the application of this discovery to man may lead to the prevention and cure of pellagra, and that nicotinic acid can be placed in the vitamin B complex.

Dr. Penrose has carried out a research on mental defect, and concludes that "the ætiology of mental defect is multiple and a facile classification of patients in the series into primary and secondary, or exogenous and endogenous cases, would have led only to a fictitious classification of the real problem inherent in the data." There is no unequivocal evidence of sex-linked germs in the causation of mental defects, but there is definite evidence in favour of Mendelian recessivity and dominance respectively in some of the rarer conditions (phenylketonuria, cretinism, microcephaly).

The experimental study of leprosy has not received close scientific investigation because there has been no means of studying it under experimental conditions. The causative bacillus of human leprosy had not been able to infect any of the lower animals on which it had been tested. Attempts to cure leprosy had to be made on lepers themselves, and in this way Sir Leonard Rogers tested the effects of compounds made from chaulmoogra oil.

In their last report the Council referred to experiments made by Mr. E. S. B. Balfour-Jones, at the farm laboratories of the National Institute for Medical Research, in which he had transmitted the bacillus of rat leprosy to Syrian harvesters. He failed, however, to transmit the bacillus of human leprosy, probably owing to the difficulty of getting fresh infective material.

In the course of the past year Professor S. Adler, of the Hebrew University of Jerusalem, paid a visit to the National Institute and was informed of Balfour-Jones's results with rat leprosy. On his return to Palestine, where he had abundant material, Professor Adler succeeded in infecting Syrian harvesters with Hanser's bacillus and produced in them a characteristic disease. If this work is confirmed the Council consider it should be possible to study the treatment of leprosy by chemotherapeutic methods.

## Clinical and other Notes.

### THE "HORAN BROWN" CAMEL STRETCHER CARRIER. A METHOD OF CARRYING CASUALTIES ON STRETCHERS FOR USE WITH CAMELS.

BY LIEUTENANT-COLONEL H. HORAN BROWN,  
*Indian Medical Service.*

It has long been realized that the apparatus used in the past for the conveyance of casualties by camel—the "Camel Kajawah"—is cumbersome and extremely painful for the patient.

This new pattern stretcher carrier is free from these two objections—the patient need not be removed from the stretchers, and he is held in



FIG. 1.—The carrier in use. A hood to cover the patient from the sun can be used if required.

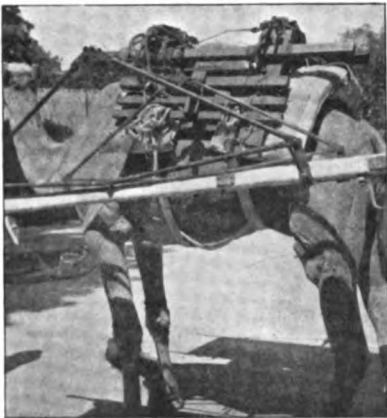
the horizontal position whatever the gradient at which the camel is moving.

The carrier can be folded, and when closed is fitted to the top of the saddle, thus permitting the camel to be used for the carriage of stores when not required to transport casualties. The stretchers, also, can be fastened on to the saddle if required.

The photographs show the carrier in use.

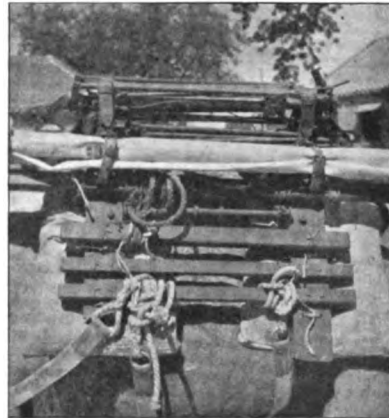


**FIG. 2.**—The carrier in use. This has been included to show what very little “cant” is caused by the difference in weights of patients. Those shown being of very disproportionate weights.



**FIG. 3.**

**FIG. 3.**—The carrier ready for use. A “close-up” of Fig. 1 to show constructional details. Note cable supports to saddle peak.



**FIG. 4.**

**FIG. 4.**—The carrier folded.

The device weighs 72 pounds, has an estimated life of ten years, and costs approximately Rs. 42.

This device has been adopted in India and details can be found in the “List of Changes in War Material and of Patterns of Military Stores for His Majesty’s Army Serving in India” (the “I.L.C.”), Nos. A-2259 and A-2261, dated March 1, 1933.



# A REPORT ON THREE CASES OF FRACTURE OF THE LOWER JAW DUE TO GUNSHOT WOUNDS IN THE FACE DURING THE WAZIRISTAN OPERATIONS, 1937.

By MAJOR H. S. GOLDING,  
*The Army Dental Corps.*

In the compiling of notes on these cases the teeth in the upper and lower jaws are referred to by the method of annotation given herewith :—

87654321 | 12345678

87654321 | 12345678

Thus reference to 34 would mean in full the left maxillary canine and first premolar teeth, 76 would mean right mandibular first and second molars, and so on.

Of these three cases the first is the most interesting, was by far the most serious, and illustrates to the full the amazing recuperative powers of

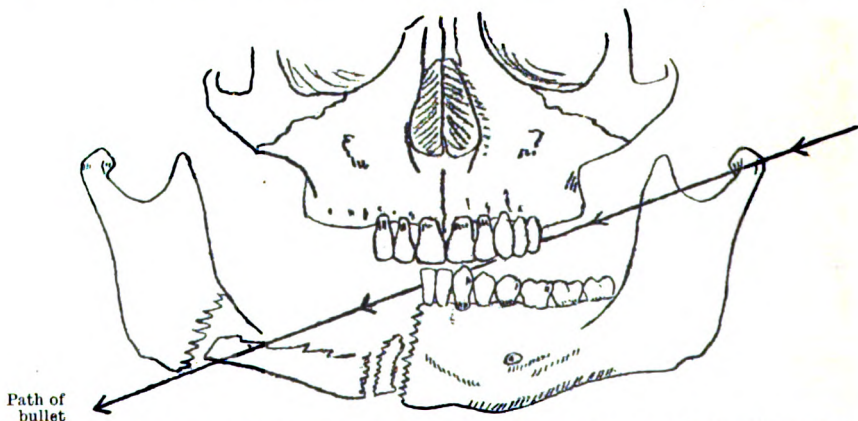


FIG. 1.—Showing approximate condition of bony fragments. In addition the posterior fragment on the right side was displaced upwards and inwards.

the tissues in the oral region, once adequate support and rigidity of the damaged parts has been secured.

(1) Captain V., 1/6th Gurkha Rifles.

*History.*—This officer was hit by a bullet (probably a dum-dum) fired from a range of about seventy yards. The bullet entered the left cheek at the level of, and removing, the crowns of 5678 leaving the roots in place. It then travelled obliquely downwards lacerating the tongue and emerged through the right cheek, causing a large wound extending from within one-eighth of an inch of the corner of the mouth to the angle of the jaw. In its course the bullet fractured the mandible on the right side in several places with considerable comminution and displacement of bone. It is

regretted that X-ray films are not available to illustrate the extent of the bony injury but the accompanying sketch may give an idea of this (fig. 1).

There was no fracture in the maxilla but 876 | 5678 were all damaged to some extent. After preliminary treatment by the medical officer the case was evacuated by air and was first seen at Murree on May 12, 1937.

*Condition on Examination, May 12, 1937.*—The patient's general condition was very serious and little could be done in the way of treatment. X-ray films showed vertical fractures in the 321 | and 8 | regions and marked loss of bony tissue in the central fragment. The posterior fragment was displaced upwards and inwards. All the lower teeth on the right

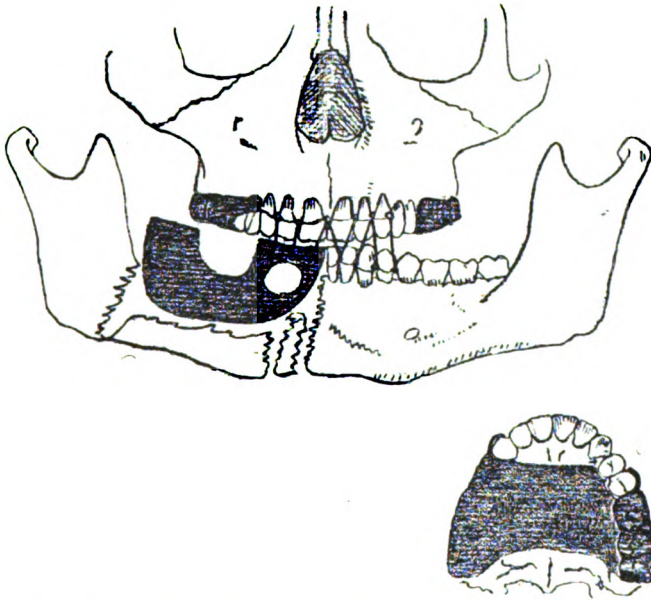


FIG. 2.—Showing vulcanite appliances and interdental wiring.

side were missing. The jaw was supported and kept in position as far as possible with a bandage which also retained the dressings for the wounds in the cheeks. All feeding was carried out by means of a tube, the anterior third of the tongue having been removed. A position of rest was maintained and hourly irrigation of the mouth carried out while damage to the soft tissues was under treatment by the surgical specialist.

May 20: The patient's general condition had improved and under a general anæsthetic (sodium evipan) the mouth was examined and fragments of teeth and necrotic bone removed where possible. While the patient was still anæsthetized an impression of the upper jaw was obtained but owing to the extreme mobility of the fragments and the extensive nature of the wound an attempt to obtain an impression of the lower jaw failed. The case was seen in the evening. Temperature 103° F., pulse 104.



May 21 : Condition had improved and temperature was almost normal. There was very considerable septic discharge from the mouth which was irrigated every hour with sodium bicarbonate and potassium permanganate (1 : 8,000) alternately by means of a funnel and rubber tube.

May 22 : To afford improved support inside the mouth a rubber tube was fitted to the buccal sulci all round the mouth, and the ends joined above the central incisors.

May 25 : It was again found impracticable to take impressions of the mandible and so an appliance was modelled in wax directly to the mouth in the lower jaw from  $\overline{8-1}$  occluding in front with  $\overline{321}$  and in the  $\overline{87}$  region with a bite block on a plate fitted to the upper jaw. The object of this was to depress and hold in position the central fragment, thus regaining as far as possible a continuous line of bone at the lower border of the jaw. After careful fitting the wax was removed from the mouth and the appliances constructed in vulcanite.

May 28 : The rubber supporting tube was now removed and the appliances adjusted and fitted to the mouth. The teeth on the left side were brought into occlusion and wired together with stainless steel wire. The lower appliance was wired to  $\overline{321}$  and in conjunction with an outside bandage gave good position and rigidity (fig. 2).

May 31 : The patient's condition was much improved, his jaw comfortable and the taking of food facilitated.

June 1 : X-rays showed fragments in good position and from this date onwards progress was steady with only minor setbacks when the apparatus had to be removed, necrotic fragments of bone extracted and the jaw rewired. For a period of six weeks the case was seen morning and evening for adjustment and irrigation, the condition of the mouth and teeth remained good and the superiority of stainless steel wire to brass was apparent in that it was more easily adjusted to the teeth, was stronger and more malleable (gauge for gauge) and, being unaffected by the acidity of the mouth, was more easily kept clean.

June 25 : The external wound had by this time so much improved that the bandage could be dispensed with and so an external support for the lower jaw was made of brass wire gauze supported by a linen head piece and slides in the temporal regions. This gave improved support and eliminated the tendency of the bandage to displace the fragments inwards. The patient's comfort was much improved thereby.

The patient continued to make steady progress until August 29, when the vulcanite appliances and wires were removed and a cast silver splint cemented to  $\overline{12345}$ . This splint carried a vulcanite extension running from  $\overline{8-2}$ , the latter extending as far as possible posteriorly and lingually. After adjustment this proved comfortable and gave adequate support. The patient was now able to open his mouth to a certain extent and also to drink from a cup. A certain amount of trismus was present but it was considered that any attempt to open the mouth forcibly should be avoided. When last seen there was every evidence of an ultimate good result.

(2) Naik K.D., 1/13th Frontier Force Rifles.

*History.*—This I.O.R. was hit by a bullet in the horizontal ramus of the mandible on the right side, causing an extensive exterior wound and large loss of bony tissue of the jaw from 7—3|. The bullet either glanced off the jaw-bone or emerged from the mouth as no exit point was found.

*Condition on Examination.*—The patient's general condition was good though the exterior wound was very septic with considerable discharge.

The mouth generally was in a very bad condition with pus exuding from the gum margins round all the teeth. It was decided to remove all the teeth except 8| and |678 and this was done under local anæsthesia at intervals of two days from June 17 to 25.

The outside wound healed very well and an attempt to obtain bony union was made by allowing the main fragment to swing round to the right and by keeping the fragments in position as much as possible by vulcanite blocks fitted to the upper and lower jaws, a four-tailed bandage being applied.

With modifications to the splints this treatment was continued until September 2, when X-rays showed no evidence of bony union. In view of the very considerable loss of bony tissue and the apparent formation of fibrous and cicatricial tissue between the ends of the fractured bone, it was decided that fibrous union was all that could be hoped for, and the patient was returned to his unit for light duty with the recommendation that dentures be eventually fitted by the Dental Officer of his area.

It was hoped that the fitting of a lower denture with clasps to 8| and |6 would provide the necessary rigidity in the mandible to enable the patient to masticate with some degree of efficiency, after he had also been supplied with a full upper denture.

A certain amount of unavoidable disfiguration was evident and the result, though good in view of the extensive nature of the wound, could only be described as partially successful.

(3) Sepoy T.S., 4/16th Punjab Regiment.

*History.*—This I.O.R. was hit by a bullet at the angle of the mandible on the right side. This occurred on April 4, 1937, and he was treated at Bannu until evacuated to Murree on June 9.

*Condition on Examination.*—When first seen at Murree on June 25, the patient's general condition was good; there was some discharge from the external wound and X-ray showed comminution of bone and fracture of teeth in 865| area. These teeth were extracted and several pieces of sequestrum removed. The teeth on the main fragment of the lower jaw were then wired into correct occlusion with the teeth in the maxilla (July 1).

On September 3, after X-ray examination had shown callus formation, the wires were removed.

There was good evidence of bony union with only very slight malocclusion, the outside wound had healed, and the patient could masticate efficiently.

After fourteen day's observation he was returned to his unit for duty.

The final result was good.

*A fourth case occurred in which the injury was caused by a kick by a horse.*

(4) Sepoy C. S. 3rd Mountain Battery R.A.

*History.*—In this case fracture of the mandible in each canine area resulted, the central fragment carrying the four incisor teeth being displaced upwards and dislocating the upper incisor teeth. The main fragment on the left was also displaced downwards and inwards.

*Condition on Examination.*—The patient was first seen in Murree on June 25, 1937, twenty days after the injury took place. His general condition was good and an impression for a lower splint was taken. 1 | 12 were extracted.

A splint was cast to a corrected model of the lower teeth, but it was found impossible to fit it as the fracture could not be reduced, even under a general anæsthetic. This was caused by apparent fibrous and possible callus formation at the site of the fracture due to the delay in referring the case to the Dental Officer.

The splint was abandoned and the teeth on the right side were wired into correct occlusion. An attempt was then made to bring the left-hand fragment upwards into occlusion by wiring under tension, adjusted daily.

The position improved rapidly. The middle fragment was also raised until the incisors (which were loosened by the original injury) met the gum in the upper jaw.

Though it had been hoped to save 21 | 12 originally, their removal was now decided on. This was done, the alveolus trimmed with bone forceps and the gum sewn into position (July 18).

By daily adjustment of the wires on the left side the fragment on the left was progressively raised, until August 21, when the wires were removed.

The position and occlusion of the teeth was not perfect, but the result was considered satisfactory subject to the provision of partial upper and lower dentures and the correction by grinding of the malocclusion present.

The patient could masticate satisfactorily and there was good evidence of bony union.

## Echoes of the Past.

### THE MEDICAL SERVICES IN FLANDERS, 1742-1748.

BY LIEUTENANT-COLONEL G. A. KEMPTHORNE, D.S.O.,  
*Royal Army Medical Corps (R.P.).*

IN the year 1742 16,000 troops were despatched to the Continent to co-operate with the Austrians and the Dutch in support of the claims of the Empress Maria Theresa. Landing in the Netherlands in May and June, they were quartered in Bruges, Courtrai, Oudenarde, Gramont and Ghent, the last being the headquarters of the Earl of Stair, the Commander-in-Chief, where they remained for the next nine months while a plan of campaign was being discussed. A small hospital establishment was



embarked with the army, consisting of a director of hospitals, Mr. John Ellis, a physician, surgeon, apothecary, six mates, and a matron. This hospital was located at Ghent; elsewhere the sick were treated in the regimental infirmaries. The physician was Dr. John Pringle, Professor of Pneumatics in Edinburgh University, whose "Observations on the Diseases of the Army," published ten years later, was for years accepted as the last word on the subject, and gives much information on the medical history of this campaign. Though his pathology has naturally been

superseded, the broad sanitary principles he laid down remain for all time, and he is rightly regarded as the father of military hygiene.

At this period, all that part of Flanders which lay between the Lys and the sea was a marshy, unhealthy area, as also the greater part of the United Provinces with Dutch Brabant from Grave downwards along the Maas. Except at Ghent, perhaps, the cantonments, which were mainly outside these limits, were fairly well situated. Zealand, surrounded by the oozy branches of the Scheldt, later the scene of the Walcheren débâcle, where four battalions were located in 1747, was notoriously malarious. Pringle notes that "the canals and ditches in which innumerable plants and insects die and rot, fill the atmosphere with moist, putrid and insaniary vapours." In his view, purefaction, whether of vegetable matter, animal excreta, or even of a gangrenous limb in a hospital ward, was the root of the intermittent, remittent, continued, putrid, or ardent fevers from which armies suffered.<sup>1</sup> He also noted the contamination of shallow wells as a contributory cause of sickness.

The troops landed in good health, and at the end of the first month had 3·1 per 1,000 in hospital or, as Pringle puts it, one-thirty-second of the force. Itch was almost universal, and was treated with sulphur ointment. Nine months later, one month after taking the field, the sick numbered 25 per 1,000. In Ghent the large proportion of men admitted from the damp, low-lying part of the town was observed. In the winter, diseases he attributed to cold were prevalent, coughs, stitches, peri-pneumonies and rheumatism. It was probably due to Pringle's insistence that some years later two blankets were issued to each tent. In the summer and autumn intermitting and remitting fever and dysenteric fluxes occurred. He describes separately the bilious remitting fever of the camp and that of low-lying marshy country. He remarks that "many remittents degenerated into continued fevers, often mortal, and the intermittents, or agues, being stopped before some proper evacuations (i.e. bleeding, vomiting, and purgings) were made or relapses secured against, changed likewise into continued fevers and ended in dangerous obstructions of the viscera." He fully appreciated the connection between neglected camp latrines and dysenteric infection. The patients admitted to the military hospitals were constantly found to be afflicted with round worms. Scurvy, though it did not apparently affect the troops in the campaign, is mentioned as "the commonest chronical disease of the country."

In February, having been joined by an equal number of Hanoverians in British pay, Lord Stair's army marched towards Germany leaving 600

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<sup>1</sup> The curious student has scope for his ingenuity in expressing in modern terms some of the fevers so vividly described by the eighteenth century physicians. According to Chambers' Encyclopædia, typhoid was differentiated in 1836, relapsing fever in 1842. Laveran described the malaria parasite in 1880, and the paratyphoids and trench fever have since to be added.

sick behind in hospital. The Rhine was crossed at Neuwied, and in May the camp was at Hoecht near Hanau, on the bank of the Main. A flying hospital, now sited at Neuwied, had been supplied from England and the medical staff had been augmented by a surgeon, an apothecary, and six mates. At the end of the first five weeks the sick numbered 220. On June 22 Stair moved to Aschaffenberg, leaving 500 patients. By this time a junction had been effected with the Austrians, raising his command to 40,000 men; but in the Duc de Noailles, who had arrived at Seligenstadt, on the left bank of the river with 70,000 to join up with the Bavarians, he had a skilful opponent, and his own dispositions were constantly hampered by the instructions sent him by King George the Second. When therefore the King joined the army in person, it had been without food or forage for some days, and its communications with the base at Hanau were seriously threatened by the enemy who were established on the left bank only four miles away cutting off supplies by water.

In anticipation of the King's withdrawal from his position, de Noailles next detailed the Duc de Gramont with 30,000 troops to cross the Main three miles in advance and occupy the defiles of Dettingen through which the Hanau road passed, an unfordable river across which artillery were posted on one side, densely wooded hills on the other, and the rest of the French Army closing in behind.

When the situation was grasped, the leading troops were hurriedly deployed. In the confusion the King's horse bolted to the rear, the Duke of Cumberland's to the front, where the latter was wounded. Having regained control, both dashed into the fray, the King on his own legs.

The trap was nearly complete when de Gramont, prematurely vacating his position of advantage, launched his men in an attack on the low ground, masking at the same time the fire of his own guns from across the river. The first line was broken but the second stood fast, and after a sharp tussle in which the French infantry showed much less than their usual form, the enemy were driven back or pushed into the river, and the march was resumed. The allied casualties in this engagement, where less than half the troops on each side came into action, were 755 killed, 1,312 wounded, and 284 unaccounted for. The French loss was 5,000. The British regiments' share was 263 killed and 558 wounded. Of the wounded, 600 were left behind to be cared for by the French who showed them the utmost consideration. De Noailles then withdrew his army into Alsace.

The night following the battle was spent by the victors in a wet bivouac. Hunger and fatigue had lowered their bodily resistance, and a week later dysentery broke out which in a few weeks infected half the army. Pringle ascribed as a cause of its spread putrid straw in the tents and neglected latrines. The village of Feckenheim was taken up for the patients' accommodation, and here 1,500 cases were sent.

The "putrid malignant fever," slow in its course, with a sunk pulse and constant stupor, which acquired the name of Typhus, was well

recognized, being usually ascribed to the inhalation of foul air in buildings such as gaols, and especially that arising from diseased persons in hospitals.<sup>1</sup> Its transmission by *fomites* was also accepted, though in a community habitually verminous the true source by which infection was conveyed was unsuspected. Within a short time this fever broke out among the patients crowded at Feckenheim.

Leaving Hanau, Wiesbaden was occupied on August 10, and Worms on the 30th, near which sick were disposed of at Osthofen and Bechtheim. In October the Army went into winter quarters in the Netherlands.

The dysentery had abated soon after leaving Hanau when the anticipated number of cases of "bilious or autumnal remitting fever" began to come in. Meanwhile 3,000 sick had been left in Germany. At Feckenheim things went from bad to worse. Of the fourteen hospital mates there, all were infected, and five died. The case mortality was 50 per cent. The typhus spread to the villages and in some cases the civil inhabitants were practically wiped out. Similar events were no doubt in the mind of the compiler of the Litany when he coupled together "plague, pestilence and famine, battle and murder and sudden death." The order which followed to concentrate the sick of the three German hospitals at Neuwied was particularly unfortunate. The Feckenheim patients infected those from Osthofen and Bechtheim. When in December the survivors were sent by water to Ghent, about half died on the way and the remainder soon after arrival.

In 1744 Lord Stair was succeeded by General Wade; the allied forces, reinforced by 10,000 troops from England, being opposed by an army of 85,000 under Saxe, who carried the war back to Flanders. Wade was unable to gain the co-operation of the Austrians or Dutch in carrying out any of his proposals, and at the opening of the campaigning season there was no plan of action. In six weeks the French reduced Courtrai, Menin, Ypres, Fort Knoque and Furnes. An abortive attempt was made to bring them to a general action on the Lys, and the following March Wade went home. At the end of the first ten weeks 600 sick, or one-forty-third of the force, were in hospital at Ghent and Brussels; at the end of the campaign the fraction was one-seventeenth. Another hospital had been opened at Tournai in August. During the winter the general hospital was maintained at Brussels, but at Ghent and Bruges barracks were handed over to the regimental surgeons, who were provided with suitable equipment at the public expense, a form of decentralization universally approved as lessening

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<sup>1</sup> General hospitals maintained their evil reputation with the Army well into Peninsula days, and were particularly notorious during the War of the French Revolution. The confusion and overcrowding which frequently prevailed was attributed by the regimental surgeons to their being administered by physicians who knew nothing of Army conditions. Whatever the rights of the case, the Army clearly owed much to the work of some of these semi-civilians.

the chance of hospital fever. A physician was detailed as consultant to each principal garrison.

In 1745 the Duke of Cumberland assumed command. Ellis, the Director of Hospitals, had been succeeded in July of the previous year by Charles Garnier, brother of George Garnier, the Apothecary General, but he died a few months later. In January, 1744-45, the post was handed over to David Middleton, the Chief Surgeon, who is credited with having secured for each patient a bed to himself and a clean change of bedding.<sup>1</sup>

In April the Allies, being about 43,000 strong, marched to the relief of Tournai, which was invested. Cumberland's headquarters were at Soignies on May 3, and at Cambron on the 4th. His routine orders issued on that date regarding camp conservancy, disposal of dead animals, and the opening up of tents in favourable weather might have been written at the present day. On the march the surgeons, with their medicine chests and instruments on batt-horses, marched with the tent wagons which were at the head of the regiments. A wagon with the sick, no doubt accompanied by the surgeon's mate, was detailed to follow each unit.

On arrival at Maubray on the 9th the French were found to the number of 56,000 in a carefully prepared position, the centre of which was the village of Fontenoy, and after preliminary skirmishing this line was assaulted on the 11th. The advance was over half a mile of open ground swept by a cross artillery fire. The centre marched steadily forward in perfect alignment, reserving their fire till within thirty yards of the French infantry, who were blasted out of their entrenchments. But Brigadier Ingoldsby, commanding three battalions on the right, who should have carried the redoubt covering the enemy's flank, failed to push the attack home, while the Dutch on the left were repulsed. The remainder, having shattered the French battalions, resisted three attacks of cavalry, halted under a heavy cannonade from the flanks, retired, reformed, advanced again and repelled another cavalry charge, withdrew, still under a cross fire, with their ranks unbroken.

The casualty list of the British, Hanoverians and Dutch showed 2,359 killed, 4,124 wounded and 740 missing, which with 400 Austrian casualties totalled about 17 per cent of the entire force. The 12th, 21st, 23rd and 31st all lost at least half their strength. There were no casualties among the surgeons; of the mates, being of warrant rank only, there is no record. In the subsequent court-martial Colonel Ingoldsby was convicted of an error of judgment only. An important witness for the defence was the surgeon called up to attend the mortally wounded colonel of the Suffolks, one of the regiments in the brigade.

After the battle a hospital was opened in the casernes of S. Roc where

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<sup>1</sup> The Directors of Hospitals were actually Directors of Hospital Supplies. They had the placing of contracts and the hiring of sites. They were not recognized by the Physicians in charge of the hospitals as their superior officers.



600 wounded were dealt with. Relations between the combatants in the intervals of fighting had hitherto been sufficiently cordial, but the behaviour of the French to the wounded on this occasion roused much indignation, the Duke protesting to Saxe that "if he intended to make war like a Turk he would learn for the future how to receive him," while the soldiers began to talk of giving no quarter. A letter printed in the *Scots Magazine* of June, 1745, states that "we surgeons sent to take care of the wounded when carried from the field were made prisoners of war and treated in a very merciless way, for not only we, but about 1,000 more were stripped of everything valuable we had, viz. watches, swords, money, and clothes, and not only so, but our very instruments were taken from us although the barbarians saw hundreds continually imploring our assistance. In this unprecedented way we remained three days, numbers dying every hour because we had nothing to dress them with." On eventually being returned to their own camp they presented the Duke with a bag of chewed balls, sword points, pieces of flint, glass, iron, etc., from their patient's wounds, which he and the other allied commanders sealed and forwarded to Saxe. The wounded referred to seem to have been collected at the Château of Bruffoel and left behind. Tournai capitulated, and on July 10 Ghent fell. Middleton the surgeon, who was in the town, asked for the wounded, some of whom he considered unfit to travel, to be left on parole, but they were despatched in carts forty miles to Lille. By October, when most of the British troops left with Cumberland for England to suppress the Scotch rebellion, Saxe had occupied all Flanders. The season closed with 1,000 sick in hospital at Antwerp, Brussels and Mons. The deaths from disease during the campaign had not exceeded 200.

Ten of the regiments embarked landed on the south coast of England after a favourable voyage and in good health. Others, delayed by contrary winds, reached Newcastle, Berwick, and Holy Island, having spent three weeks crowded in the hold. Malignant fever broke out, the hospital established for the Army at Newcastle was infected, where the nurses took the disease, and an apothecary and four apprentices died. Ligonier's and Price's regiments landed 97 patients at Holy Island of whom 40 died. The civil population, 350 in number, also had 50 deaths. The winter cold of Scotland naturally also caused many relapses of malaria.

During 1746 the Allies under Prince Charles of Lorraine were manœuvred back to the Dutch frontier. Fatiguing marches and bad weather caused considerable sickness, and in October the small British force remaining had a quarter of its strength in hospital.

The Duke of Cumberland resumed command in 1747. The concluding years of the war were gloomy and depressing ones relieved only by the indomitable courage of the British and Hanoverian troops when given a chance to display it. Co-operation with the Austrians and Dutch was increasingly difficult. In May the French, having occupied Dutch Flanders, prepared to invade Zealand. In July Saxe won a success over the combined

forces at Laeffelt, the Austrians holding back from the fight and the Dutch stampeding. Eight hundred wounded were brought into Maestricht, who were housed in a large church. The spacing was adequate, and no cases of hospital fever occurred. In August there was much dysentery which spread among the peasantry in the occupied villages. In November there were 4,000 sick in a strength of 20,000. Of these half came from the four battalions in Zealand.

In 1748 Maestricht was besieged, but still held out when the preliminaries of peace were signed at the end of April. The low-lying areas of Brabant were flooded, and in July and August cases of "ardent fever" occurred, apparently a pernicious type of malaria. In mid November the British sailed for England, when 400 cases of typhus contracted on the voyage were admitted to the hospital formed at Ipswich. Pringle says that the distemper abated when the principle of boarding out the convalescents was adopted.

In 1744 John Ranby published a small work on the method of treating gunshot wounds, illustrated by cases he saw at the battle of Dettingen, which reached a third edition in 1781. He considered that amputations as well as dressings should be done on the field of battle at the earliest possible moment, for which purpose dressing stations should be formed by the surgeons of three or four adjacent regiments close behind the line. He mentioned the evil results of meddlesome surgery and indiscreet exploration with the bullet forceps and probes twelve to fourteen inches long supplied in the surgeon's chest. He would also dispense with chisels and mallets. Unless the wounded man had already lost a very considerable amount of blood, he should be bled at once. He took twenty ounces from the Duke of Cumberland's arm for a grape-shot wound in the calf of the leg, and bled him for the next two days with a view to preventing inflammation, also giving emollient clysters. He was a firm believer in the value of bark when sepsis ensued. He mentioned seeing three cases of tetanus after the battle. The third edition of his work contains also some notes on the conduct of regimental infirmaries. In recommending the free provision of trusses, he refers to "one Ramsay, a rupture monger, who at the desire of a very principal officer of the Army had had a hospital established for him in Flanders, where he carried out severe and painful experiments."

#### MEDICAL STAFF.

DIRECTORS AND PURVEYORS: John Ellis, March 1741-42; Charles Garnier,<sup>1</sup> July 1743; David Middleton,<sup>2</sup> Jan. 1743-44; James Cathcart,<sup>3</sup> Dec. 25, 1747; James Pringle (controller), June 1, 1745. PHYSICIANS: John Pringle,<sup>4</sup> 1742; Alexander Sandilands,<sup>5</sup> 1742; John Bailey,<sup>6</sup> 1743; Clifton Wintringham,<sup>7</sup> 1743; James Maxwell, 1743; John Barker,<sup>8</sup> 1747; John Clephane, 1747. SURGEONS: Robert Adair,<sup>9</sup> 1742; George Lawman, 1742; Francis Mitchell, 1742; John Ranby,<sup>10</sup> 1743; John Andrews,<sup>11</sup> 1743; David Middleton, 1743; James Wilsford,

1743 ; Pennel Hawkins, 1744 : James Napier,<sup>13</sup> 1744. APOTHECARIES : Salisbury Lloyd,<sup>18</sup> Aug., 1742 ; William Ore, March, 1742 ; Edward Bligh, Sept. 1747.

#### NOTES.

<sup>1</sup> Brother of George Garnier, the apothecary general, died 1744. <sup>2</sup> Surgeon, Life Guards 1732, chief surgeon, Flanders, 1743, surgeon general 1748. <sup>3</sup> He was director and purveyor in the Carthage expedition, 1740, and in N. America, 1746. <sup>4</sup> Sir John Pringle, Bart., M.D., F.R.C.P., F.R.S., physician general in Flanders, 1744, present at Dettingen, died 1782. <sup>5</sup> Served in Flanders, 1709, physician at Gibraltar, 1726-27. <sup>6</sup> Present at Dettingen, died at Ghent, 1744. <sup>7</sup> Baronet and physician in ordinary to King George III, 1774, physician general, 1786, died 1794. <sup>8</sup> Physician, Westminster Hospital, 1746. <sup>9</sup> Afterwards Inspector of Regimental Hospitals. The hero of the song, "Robin Adair." <sup>10</sup> Serjeant surgeon to George II, surgeon 2nd troop L.G. 1736, master of the surgeon's company, 1745, present at Dettingen, died 1773. <sup>11</sup> Formerly surgeon 2nd troop H.G.G., surgeon general Low Countries, March 11, 1744. <sup>12</sup> Superintendent of Hospitals in America, 1777, Knighted, 1778. <sup>13</sup> From 53rd Foot.

#### REGIMENTAL SURGEONS.

The following surgeons, assuming they were with the regiments, were present at Dettingen, 27.6.43, and Fontenoy, 11.5.45. The names are mainly from Johnston's Roll.

HORSE GRENADIERS : 2nd troop, John Andrews.<sup>1</sup> R.H.G. : John Bohannon, 1734-Nov. 1745. 7TH D.G. : Francis Home,<sup>2</sup> 1742-49. GREYS : Thomas Glen, 1742-50. 3RD HUSSARS : John Kennedy, 1741-44. 4TH HUSSARS : John Watson, 1742-47. COLDSTREAM GUARDS : William Ellis, 1734-47. SCOTS GUARDS : James Pringle, 1728-48. ROYAL SCOTS \* : John McColme, 1744-67. 3RD FOOT : Archibald Johnson, 1734-46. 8TH : William Young, 1739-Sept. 1745. 11TH : John Wood, 1742-49. 12TH : James Stevens, 1732-44 ; Samuel Ryder, 1744-50. 19TH : William Hamilton, 1744-60.\* 21ST : David Ramsay, 1742-Aug. 1745. 28TH : Henry Cunningham, 1744-56. 31ST : James Chalmers, 1744-60. 32ND : Peter Mackenzie, 1741-60. 37TH : John Bouchier, 1727-46. 42ND : James Monro,<sup>3</sup> 1739-46.\* UNIDENTIFIED : Life Guards, K.D.G., 6th Dg.,\* 13th Foot, 20th, 23rd, 25th,\* 28th,\* 33rd, 34th.

The starred regiments were at Fontenoy only. The 4th and 37th Hussars were not at Fontenoy.

#### NOTES.

<sup>1</sup> Appointed staff surgeon, July 20, 1743. <sup>2</sup> Francis Home, M.D. Edinburgh. Professor of Materia Medica, 1768. He studied at Leyden in the intervals of the war [*vide* D.N.B.] <sup>3</sup> First M.O., Black Watch. Killed with his brother, who was lieutenant-colonel of the regiment, at Falkirk, 1746 [*vide* Stewart, "Sketches of the Highlanders"].

## Current Literature.

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HALLDEN, G. Quelques considérations sur la résistance à l'égard de la variole chez les vaccinés et les non vaccinés. [**Resistance to Smallpox among Vaccinated and Unvaccinated Persons.**] *Bull. Office Internat. d'Hyg. Pub.* 1937, v. 29, 1865-84, 5 figs. [21 refs.]

In the pre-vaccination epoch smallpox was mainly a disease of early life and figures are quoted showing that 95 per cent of the cases occurred in the first ten years of life. The total number of smallpox deaths in Sweden progressively diminished from 71,251 in 1749-58 to 32,807 in 1799-1808. As this reduction coincided with an increase of population it must have been due either to a reduced virulence or to an increased resistance. As contemporary clinical accounts give no indication of any change in virulence, the author assumes that the latter explanation is the true one. As inoculation was never widely practised in Sweden, it must be assumed that this increased resistance was in some way due to the repeated outbreaks of smallpox which occurred during this period. Gins has maintained that heredity is a factor in this increased resistance, a theory to which the author is unable to subscribe.

Two questions of paramount importance are: Firstly, the extent to which herd immunity has been modified by the practice of infant vaccination; and secondly, the degree of resistance of unvaccinated persons. Various methods have been applied to ascertain the answer to the first question. Estimates based on an assumption that the protection lasts for a given number of years (e.g. ten years, as stated by the English Committee on Vaccination, 1898) take no account of the fact that the immunity disappears gradually and a certain amount may remain for many years. The estimates of the degree of herd immunity arrived at thus are too low. Estimates based on the reaction of immunity on revaccination showed varying results in different hands. Arrhenius took the percentages of attacks to population among the vaccinated and unvaccinated, and from these deduced a figure which he called the "percentage protection against morbidity," by which he meant the difference in the percentage of attacks among vaccinated and unvaccinated calculated as a percentage of the unvaccinated rate. This method takes no account of the large number of the population who, in an epidemic, are never actually exposed to infection, and the figure is therefore unreliable. The author suggests that a more reliable method of estimating the extent of immunity would be to compare the number of cases occurring to the total number of persons actually exposed to infection. A comparison of this sort can be made by taking the number of persons infected in a family by a primary case which was not discovered until secondary cases occurred. It can also be made

with fair accuracy in outbreaks where cases have been nursed at home. He has been able to ascertain the necessary data regarding cases occurring in all Sweden between 1900 and 1917, regarding an isolated outbreak in a village in 1892-93, and regarding the Sheffield outbreak of 1887-88. The percentage incidence in exposed persons is tabulated according to age, all those considered in the first two instances having been vaccinated in infancy, and in the case of Sheffield the particulars are given separately for the unvaccinated and for those vaccinated in infancy only, revaccinated persons and those who have previously had smallpox being excluded. The fact emerges that the percentage incidence among vaccinated persons increases with each decennium up to 20—30 years (in the Swedish cases 30—40 years) and then decreases. Among unvaccinated persons the maximum incidence is on the first two decennia (86·6 and 91·6 per cent respectively) and afterwards decreases progressively to 20 per cent at ages over 40. The explanation suggested is that during successive earlier outbreaks there have been a number of latent cases or *variola sine exanthemate* which have conferred immunity. This would also explain the fact, stated by Voltaire, that only some 60 per cent of all people are attacked by smallpox, a fact difficult to explain in prevaccination times in view of the highly infectious nature of the disease.

O. K. WRIGHT.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

FOLEY, H., & PARROT, L. *Rickettsia* du trachome. [*Rickettsia* in Trachoma.] *Arch. Inst. Pasteur d'Algérie*. 1937, v. 15, 339-51, 3 pls. (1 coloured). [15 refs.]

After Coles in 1931 demonstrated the presence in sheep of a conjunctivitis due to a form of rickettsia, several research workers have examined trachoma from this point of view. Several have shown similar organisms; Busacca called the bodies he discovered *Rickettsia trachomæ*. Thygeson showed that the inclusion bodies of Prowazek closely resembled rickettsia in their coloration. A little later Cuénod and Nataf claimed to have cultivated rickettsiæ from trachoma in the intestine of lice and to have reproduced trachoma by inoculation of the conjunctiva by material from such lice.

Poleff has grown the rickettsia for a time *in vitro*. The authors of the present paper also have made researches and regard the rickettsia as the cause of trachoma; they treat Cuénod's statements somewhat cavalierly and say that the bodies he describes are certainly not rickettsiæ, and that if lice inoculated by him grew rickettsia in the intestine, there must have been accidental infection from some other source.

HAROLD GRIMSDALE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

## Reviews.

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**RECREATION AND PHYSICAL FITNESS FOR YOUTHS AND MEN.** Board of Education Physical Training Series, No. 15. London: H.M. Stationery Office. 1937. Pp. 285 with 285 figs. Price 2s. 6d.

This is the first book of its kind to be published by the Board of Education.

The underlying aim is to attain and maintain physical fitness among those who have passed school age. It contains a mass of useful information and achieves its object, which is to act as a guide to organizations, teachers and leaders of physical training.

The suggested Tables of Exercises, suitable for varying conditions, and the information and instruction on boxing, wrestling, dancing, athletics, swimming and camping should prove invaluable to all those interested in this movement.

One criticism may be mentioned; it is that the Tables of Exercises commence with some rather vigorous running about without any preliminary warming up. This is not in accordance with the teaching and practice of the Army School of Physical Training.

The indoor activities are intended to create a desire for fitness and to act as a link with, and form an inducement to continue, outdoor activities in the form of field games during the summer.

The physical ability tests at the end of the Tables are good. They create interest and enable the student to assess his progress and stimulate pride in the skill attained.

W. C.

**BIOLOGY OF WATER SUPPLY.** British Museum (Natural History) Economic Series No. 7A. By Anna B. Hastings, M.A., Ph.D. London: Printed by Order of the Trustees of the British Museum. 1937. Pp. 48. Price 1s.

The first paragraph of the Preface states: "This pamphlet has been largely rewritten in order to adapt it to a newly-arranged and more extensive exhibit of the Biology of Water Supply."

The pamphlet first gives an illustrated description of the more common plants and animals gaining access to water supplies. The illustrations might be more numerous, as only twenty-five out of about forty plants and animals are illustrated, and identification is sometimes difficult when only a description is given.

There follow descriptions of conditions of life in rivers, treatment of river water including filtration and chloramination, a short description of tests of purity of treated water and of the delivery of water to the consumer. The book then treats of wells, springs and lakes as sources of water supply. It utters a warning against the omission of filtration in the treatment of

supplies, mentions iron and sulphur bacteria and their action and gives a brief description of the history of water treatment. A classification of the various plants and animals follows, and the pamphlet finishes with references and an index.

Although the pamphlet cannot compete with a book like "Whipple's Microscopy of Drinking Water," it is a very good popular résumé of the subject and very well fulfils the purpose for which it was written.

**THORACIC SURGERY.** By Ferdinand Sauerbruch, Professor of Surgery in the University of Berlin, and Laurence O'Shaughnessy, F.R.C.S., Hunterian Professor in the Royal College of Surgeons of England, etc. Imperial 8vo. Pp. viii + 394. London: Edward Arnold and Co. 50s. net.

This important book is a revised and abridged edition of Sauerbruch's "Die Chirurgie der Brustorgane," and the authority of Professor Sauerbruch, together with the original approach to some of the problems by Captain O'Shaughnessy, have combined to make it of more than usual interest.

After a consideration of the Function of the Lungs, General Diagnosis and the Technique of Thoracic Operations, the authors pass to a detailed description of the Surgery of the Chest Wall and Organs. By their descriptions the authors show how widely the indications for surgery in the chest, and its possibilities, have spread in recent years, and it is their aim to enable a greater number of sufferers from thoracic disease to benefit from surgical intervention.

They summarize their views of the treatment of wounds of the lung and pleura in war, and quote the British experience of the lowered mortality which followed when these cases were operated on in the forward area. There is no doubt that surgeons will be in a much better position to deal with chest wounds if, unfortunately, they are ever again called on to do so under war conditions. The improvement in technique and the greater experience of chest surgery alone will ensure this.

This book is beautifully produced and illustrated, and the bibliography occupies 22 pages. The authors and publishers are to be congratulated on the appearance of a book which should be in the hands of all military surgeons and all military medical libraries. D. C. B.

**THE PRINCIPLES AND PRACTICE OF RECTAL SURGERY.** By W. B. Gabriel. Second Edition. Pp. x + 364. 1937. London: H. K. Lewis and Co. Price 28s. net.

This is a book which should be available for reference in every military hospital library. It not only gives an account of major surgery such as carcinoma of the rectum, but also gives detailed instruction in the diagnosis and treatment of minor ailments. Piles, fistulæ and pruritus ani are dealt

with fully, and these are conditions in which the general surgeon is often glad of advice from a specialist, such as Mr. Gabriel.

The anatomy of the region is dealt with at length ; but it is a pity that the pile-bearing area is referred to in one place as being part of the anal canal, whereas elsewhere it is spoken of as being part of the rectum.

In the treatment of a thrombosed external pile no mention is made of the simple operation of incision and evacuation of the clot, followed by suture—a procedure which rarely fails to cure.

These are minor criticisms of an excellent book, which is well printed on good paper and freely illustrated. Some of the coloured plates are particularly good.

C. M. F.

## Correspondence.

### WILSON-WEIL-FELIX TEST.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—In my paper on Typhus Fevers in the March and April numbers of the Journal the serological test for such fevers is referred to as "the Weil-Felix" and not, as by me in the manuscript, as "the Wilson-Weil-Felix."

From the printer's point of view the omission of Wilson's name may have the advantage of brevity. From any other point of view it is undesirable since it is unfair to the pioneer work of Wilson in this field and conforms with a regrettable tendency in current literature to obscure his name and the role he played in the elaboration of this important test. To him we are indebted for the original demonstration of the principle of the test, upon which the work and modifications of Weil and Felix several years later were wholly dependent.

For these reasons I was meticulous in my nomenclature and for the same reasons I now feel compelled to draw attention to the discrepancy which unfortunately has appeared in the Journal under my name.

Larpool Lodge,  
Farnham, Surrey.  
June 6, 1938.

I am, etc.,  
BASIL BLEWITT,  
Captain, R.A.M.C.

### MECHANIZATION AS IT AFFECTS THE MEDICAL SERVICE.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—In his article on the problems of mechanization Colonel Atkins expressed the hope that he might stir up some correspondence, and encouraged by this I would like to refer to his suggestion that we might often have one dressing station instead of two.

Mechanization has enabled the Divisional R.A.S.C. to eliminate one link from their chain in the forward movement of supplies, the Divisional



Maintenance Company having disappeared, and supplies being taken over direct at Supply Railhead by the Supply Column.

It has seemed to me for some time that we should similarly eliminate a link from our chain in the rearward movement of wounded, and so avoid unnecessary handling of the wounded, and speed up the process of evacuation. The disappearance of the horsed ambulance wagon abolishes the need for a stage at which wounded are transhipped from horsedrawn to mechanical vehicles, and if roads are at all good it seems quite superfluous to attempt any such transhipping in a journey of five to ten miles. If the A.D.S. could be eliminated the wounded would be evacuated to M.D.S.s (one per Brigade, a single divisional one, etc., according to the nature of the operations), through a network of car posts, the number and distribution of which would depend on the roads allotted for evacuation purposes, and other factors. It would not be necessary for an officer to be always at each post, and one officer in a car could supervise more than one post. Car posts could be easily concealed, and the substitution of one or two of them for an A.D.S. would avoid putting all our eggs in one basket, whilst they could move very rapidly to conform with an advance or withdrawal. The Field Ambulance, instead of being organized to provide a M.D.S. and two A.D.S.s, might, like the C.C.S., consist of a heavy section—the usual M.D.S.—and a light section, capable of more rapid movement, which could push on behind the car posts, and function until a more complete M.D.S. could be got forward. Elimination of the A.D.S. would of course make some form of W.W.C.P. essential, whilst the distance from the front to the first dressing station would seem to call for some forward centre for decontaminating mustard-gas cases—a big problem which we are directed by the latest Army Training Memorandum to study this year.

In such a scheme of evacuation the Field Ambulance would still retain its present functions, but it seems possible that, if this unit is to retain the mobility essential for keeping up with a rapidly moving mechanized force, it may find that it cannot establish any very fixed dressing stations at all, and that the actual collection of wounded may be about all it can manage. The M.D.S. might therefore conceivably become, not the most rearward establishment of the Field Ambulance, but a forward establishment pushed up by the C.C.S. to which cases would be sent from a network of C.C.P.s, more or less elaborate according to the situation established by the collecting Field Ambulance. Such an adaptation, if found feasible, would relieve the Field Ambulance of much clerical work, and would necessitate the attachment of some of its clerks to the C.C.S., unless the War Establishments of the units were appropriately amended.

During tactical exercises with the Highland Division we have often thought that evacuation through C.C.P.s to a M.D.S. direct would work well, but one must admit that such exercises have an unvoidable air of unreality, so well illustrated in *Punch's* picture of the subaltern replying to an umpire cursing him for crossing a bridge "supposed to be destroyed,"

with a cheerful "That's all right, sir, we're supposed to be swimming." In war the use of many of the roads which we use so cleverly on paper would be denied to us, and it is perhaps questionable if we would so confidently abandon the routine method for one less orthodox when the lives of real casualties were at stake. It should, however, be remembered that much the same scheme as that outlined here was adopted by the 1st and 5th Armies in 1918, and apparently worked well. The single dressing stations used were called A.D.S.s, but as they used the equipment, etc., of the tent divisions they were really what we know as M.D.S.s, the A.D.S. being represented by car posts.

It would be interesting if officers who saw this scheme in practice would tell us of its advantages and drawbacks.

Perth,  
May 30, 1938.

I am, etc.,  
F. M. RICHARDSON,  
Major, R.A.M.C.

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## Notices.

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### THE LEISHMAN MEMORIAL PRIZE.

LIEUTENANT-COLONEL E. V. WHITBY, R.A.M.C., has been awarded the Leishman Memorial Prize for the year 1937, consisting of a silver medal and a sum of £30 (thirty pounds).

The Leishman Prize (Officers) is awarded annually to an Officer of the Royal Army Medical Corps or The Army Dental Corps for work of outstanding merit.

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### NORTH PERSIAN FORCES MEMORIAL MEDAL.

EDGAR COCHRANE, Esq., M.D., D.P.H., Medical Officer (Health), Gold Coast, has been awarded the North Persian Forces Memorial Medal for the year 1937 for his paper on "Tuberculosis in the Tropics," published in the *Tropical Diseases Bulletin*, 1937, volume xxxiv, Nos. 10 and 11.

The North Persian Forces Memorial Medal is awarded annually for the best paper on Tropical Medicine or Hygiene published in any journal during the preceding twelve months by a medical officer, of under twelve years' service, of the Royal Navy, Royal Army Medical Corps, Royal Air Force, Indian Medical Service, or of the Colonial Medical Service.

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### THE ALEXANDER MEMORIAL PRIZE.

MAJOR C. V. MACNAMARA, R.A.M.C., has been awarded the Alexander Memorial Prize for the year 1937 consisting of a gold medal and a sum of £40 (forty pounds).

The Alexander Memorial Prize is awarded annually to an officer of the Royal Army Medical Corps for professional work of outstanding merit.

**COMMANDANT, OFFICERS' CONVALESCENT HOME,  
OOTACAMUND.**

APPLICATIONS are invited for the post of Commandant of the Officers' Convalescent Home at Ootacamund for retired European officers of the Indian Medical Service or the Royal Army Medical Corps.

The terms of the appointment are :—

- (i) Salary of Rs. 300 per mensem in addition to retired pay, plus free quarters, lighting, fuel and board for himself and his wife, who will assist him.
- (ii) The tenure will be for so long as the officer's services are required, and will be subject to three months' notice on either side.
- (iii) The officer will normally be required to vacate the appointment on attaining the age of 57. An extension for a specified period may, however, be granted.
- (iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorised representative shall be the sole judge.

2. Applications should be addressed to the Director of Medical Services in India, Army Headquarters, Simla, and should reach him by July 15, 1938. The selected officer will be required to join the appointment on October 15, 1938.

3. This supersedes the "Notice" published in the February and March issues of the Journal.

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**KING EDWARD VII CONVALESCENT HOME FOR OFFICERS  
AT OSBORNE.**

OSBORNE HOUSE, East Cowes, Isle of Wight, formerly the Island home of Her Majesty the late Queen Victoria, was given to the nation by H.M. King Edward VII as a Convalescent Home for Officers.

The House, which is situated on the Solent in an exceptionally beautiful park of 240 acres, was duly converted into a most delightful and comfortable Convalescent Home for the reception of : (a) Officers, both serving and retired, of the Defence Services ; (b) Cadets of the Defence Services ; (c) Serving Civil Servants ; (d) Retired Civil Servants who have been required to serve abroad.

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**THE TRANSPORT OF CASUALTIES BY AIR.<sup>1</sup>**

BY AIR COMMODORE A. S. GLYNN,  
*Royal Air Force (Medical Branch).*

THIS subject is one which may well prove of real interest in the future and one that has great possibilities, but at the very outset I would like to disillusion anybody who has visions of mass evacuation of casualties by air; for various reasons which will become apparent during my talk, this wholesale clearing of, say, a casualty clearing station would not be practicable, but the aeroplane can, and does, prove of the utmost value in certain types of cases and in certain situations.

Aircraft must never be looked upon as the prime means of evacuating casualties in war, but as a very valuable addition to the existing mechanical means of transport used for this purpose. Motor ambulances, ambulance trains, ambulance barges, hospital ships, even lorries, tenders, buses, etc., in emergency, are all essential and are invaluable in their own element, they can never be replaced, but the aeroplane will do something that these other means of transport can never do, that is take cases in the shortest space of time with a minimum of discomfort over the worst possible terrain to a hospital where expert skill and nursing are available. By this means not only is it possible that lives may be saved (which in itself is a wonderful thought), but also by reason of receiving this early expert treatment a casualty might be made fit to return to the fighting line which he otherwise might not have been if the treatment had been delayed, or at least he would be made fit in a shorter space of time. Here I might insert a very appropriate quotation from the introductory chapter of Nicholls' recent book

---

<sup>1</sup> Lecture to the Royal Army Medical Corps, Aldershot.

“Organization, Strategy and Tactics of the Army Medical Services in War,” he says :—

“Modern methods of surgery require very early treatment of wounds. An abdominal wound, for example, should be operated on within about six hours if the man is to stand any chance of survival ; and in general it may be said that every two hours’ delay means an extra week in hospital.”

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This alone, in my opinion, is justification enough for the more frequent use of aircraft.

One of the essential functions of a medical organization in war is the collection of sick and wounded and their evacuation from the fighting zone ; another equally essential one is to get these men fit and return them to their duty in the shortest space of time, and to this end casualties must be transferred to the most suitable hospital by the most expeditious means available.

In modern warfare there are so many factors at work in the destruction of man and material that the evacuation of casualties will become increasingly difficult, and with these increasing difficulties there is likely to be less efficient medical treatment in the forward areas, partly through inability to obtain adequate medical supplies and partly through the strain put upon the medical officers and personnel, and these are bound to have their effect on the morale of the troops.

Previously a battle was a narrow belt of activity, and anywhere beyond about a mile from the firing line was comparatively safe ground. Where in modern warfare will such safe ground exist? To-day we have the long-range gun dealing destruction ten, fifteen and even twenty miles behind the firing line, we have the gas attack and we have the bombing aircraft which can drop its bombs some hundreds of miles away, and so the field of potential casualties is vastly increased, the danger zone will no longer be a more or less well defined area, and casualties can be inflicted so suddenly and unexpectedly in localities well outside a definite zone that one can foresee the greatest difficulty in organizing efficient treatment in the forward areas, and in the “forward areas” I include casualty clearing stations.

The objectives of the guns and aircraft will be concentrations of troops, dumps, aerodromes, railways and roads. You have therefore an increased casualty list with a decrease in the facilities for evacuation by the destruction of those vital arteries, the roads and railways. The result can only be congestion at the casualty clearing station and a definite lowering of the morale of the troops ; the morale of the wounded would be considerably affected by virtue of the fact that roads and railways have been destroyed and with them their chances of early evacuation out of the danger zone ; the morale of the troops, too, would naturally suffer. I can imagine little more demoralizing both for the casualty himself and for the fit soldier than

to have large numbers of wounded lying about, especially when there is apparently little hope of early evacuation.

It must be remembered that a casualty clearing station is a mobile unit, but the state of affairs I visualize above renders it entirely immobile, a condition which is eminently to be avoided.

Here, then, is a chance for the aeroplane. If suitable aircraft were available in sufficient numbers (available, that is, when they were required and not only when they could be spared from other duties), and if judiciously utilized, it would mean (1) the early and rapid removal of casualties whose presence in the fighting zone is an embarrassment to operations ; (2) the quick transport of serious cases to a base hospital where the necessary specialist treatment is readily available ; (3) a more equitable distribution of cases to the various base centres without overcrowding any one ; (4) it would mean that the surgical teams in the forward areas would not need to work themselves to a state of exhaustion as frequently happened in the Great War ; it may even mean that there would not be the same need for so many specialists in the forward areas, and these could be concentrated at the bases where their energies could be conserved and the most efficient use made of their services ; (5) there would be less congestion on the lines of communication, allowing freer use of the roads and railways for other essential services, and in addition to these there is (6) the psychological effect on the patient. Can you appreciate the feeling of relief from anxiety, the utter repose and contentment in a suffering human being to know that he is being whisked away from the danger zone, and that within the space of a few short hours he will be in a clean comfortable bed having all the best care and attention lavished on him, instead of bumping and grinding along a road or railway for interminable hours or even days ?

I do not claim infallibility for the aeroplane, like everything else it has its limitations, and the greatest of its enemies is the weather. There may be quite long periods when it would be unsafe, or at least unwise, to take the risk of leaving the ground, then it is that it would be quicker to evacuate by road and rail ; but this I do claim, that, given reasonable weather conditions, the aeroplane is the most efficient means of transporting casualties that exists ; it is quicker, taking only a small fraction of the time taken by any form of land or water transport ; it is more comfortable in that you fly smoothly through the air instead of bumping over rough roads or suffering jolts and jerks from frequent stoppages and shuntings on the railway, and it is safer. Yes, it is safer ; believe me you are safer in the air to-day than you are on the roads, and in a war area you have the added danger of the enemy searching out the roads and railways with their long range guns and aircraft.

Before discussing any further the aspect of the aeroplane as ambulance transport in its relation to war, let me tell you something of what has been done in this way in recent years, and to begin with it may interest you to hear the story of the short-lived air ambulance in the Royal Air Force, and

by "air ambulance" I mean an aircraft specially designed or modified for the conveyance of casualties, and used only for that purpose.

The earliest British air ambulance authorized was built in 1919; it was an Armstrong-Whitworth machine modified to the design of two medical officers then serving with the Royal Air Force; it was never used. In the same year another medical officer with the Royal Air Force evolved an aerial ambulance by modification of a D.H.6 at Moascar, Egypt, but there is no record of it ever having been used for the purpose of carrying casualties.

The first occasion on which a specially designed and officially designated aerial ambulance was used was with what was known as "Z" Expedition. This was a Royal Air Force punitive expedition of 214 all ranks that went out to Somaliland in the autumn of 1919 to settle the account of that then hardy annual the "Mad Mullah," whom many of you will know of. So successful was this little expedition that "Z" Force was finally disbanded at Suez in April, 1920, and the "Mad Mullah" has never given any more trouble. Incidentally this expedition was of further interest in that it was the first occasion on which medical arrangements were controlled entirely by the Royal Air Force Medical Service.

The aerial ambulance accompanying "Z" force was a D.H.9, modified and adapted to carry one stretcher and an attendant and was more or less in the nature of an experiment, but it very quickly justified its existence and proved itself to be of the utmost value. To quote one instance, the first case was an officer of the Camel Corps who, although suffering from a septic toe, insisted on carrying on in the hunt for the Mullah; the result was that he developed a septicæmia and was carried into the advanced aerodrome on a litter where he arrived in a state of collapse with a temperature of 104° F. The aerial ambulance happened to be there, the patient was emplaned as a stretcher case and transferred to the advanced hospital seventy-five miles away in less than an hour. If there had been no air transport, the journey would have taken three and a half days by camel, with what disastrous results may well be imagined. After a short interval for recovery from shock, the foot was opened and treated, the temperature came down and the condition was relieved, so after a few days rest he was again emplaned and flown to the Base Hospital at Berbera where he steadily made a complete recovery. That case in itself was sufficient proof of the value of aircraft, particularly in desert country, because without doubt it saved that man's life.

In 1920 the first Royal Air Force aeroplane ambulance for duty in Iraq was sent to Egypt and erected at Aboukir. This aeroplane became unserviceable in 1922 before reaching Iraq and without carrying any cases. Two further ambulances marked with a Red Cross were erected at Aboukir; one, completed in the winter of 1922-23, was damaged on its way to Iraq and was returned to Aboukir for repair, the other arrived in Baghdad early in 1923, but within a few weeks it met with an accident and was never flown



again. Early in 1924 the repaired ambulance from Aboukir reached Baghdad and was the last air ambulance as such to be used in the Royal Air Force. In October, 1925, the Red Cross was deleted and the aeroplane came on to the strength of troop carriers, and so ended the short and rather inglorious life of the air ambulance in the Royal Air Force. Still I must say I can see no real justification for the air ambulance in the Service in peace time, because ever since 1924 all troop carriers allotted to overseas commands are modified so as to be readily converted locally to carry stretchers. This is done by the fitment of metal frames somewhat similar to those used in a road ambulance.

With the exception of the single seater fighter, any aircraft can be used for the conveyance of cases, the ideal, of course, being the twin engined bomber transport machine such as the Vickers Victoria or its latest modification the Valencia. In these machines five stretcher cases can be carried in addition to a few sitting cases and an attendant, while a new type Bristol aircraft is in existence, but not yet in production, capable of carrying ten stretchers. In all these medical supplies could be carried and there is ample space for treatment to be afforded while in flight. Urgent lying cases are also carried on the smaller aircraft so long as no treatment is required *en route*, but on these smaller types it is necessary to use the Neil Robertson stretcher. This device may be unfamiliar to some of you and for your benefit I will explain that it has been in use in the Navy for many years and is invaluable for conveying lying cases through parts of a ship where it would be impossible to manœuvre a stretcher. The Neil Robertson stretcher consists of canvas with split bamboo fixed to it longitudinally, rather reminiscent of our old friend Gooche splinting.

The patient is thoroughly encased in this splinting and carefully wrapped up in a strong impervious canvas covering provided with a hood, to protect him from the wind and sun. He thus becomes practically immobilized and can be handled with freedom with little or no fear of aggravating his condition. He is now inserted into the interior of the fuselage through the bomb opening in the floor, but this is not often possible owing to the construction of the aircraft, and it is more usual to fasten this bundle of humanity on the outside on top of the fuselage. This may sound a very precarious and terrifying method of travel, but actually it is quite comfortable.

The smaller aeroplane has the advantage of being able to land where a larger machine could not, and of rapidly conveying an urgent case to a place where appropriate treatment is procurable, when the seriousness of the case forbids delay in waiting for a larger machine. All our squadrons overseas have these stretchers on their charge available in case of emergency.

Prior to 1923 the transport of casualties by air was rather in the nature of experiment, but since that time this method has steadily grown until now it is the routine method in some overseas commands, particularly Iraq.

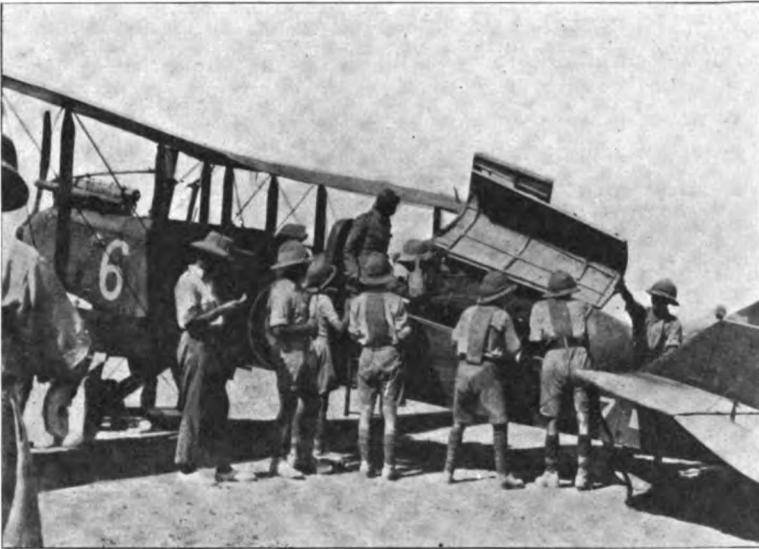
That country, owing to the nature of the terrain, the absence of roads and the scarcity of railways, is ideal for the exploitation of the aeroplane as a means of transport, and nowadays full advantage is taken of it.

The first serious attempt at evacuating casualties was in April, 1923, when 198 cases of diarrhoea and dysentery occurring amongst a column of British troops operating in Northern Kurdistan were transferred by air from near Rowanduz to Kirkuk and thence to Baghdad; the entire journey amounted to 9,615 miles and was completed in 128 hours 45 minutes actual flying time. In addition to these, in the same year (1923) a large number of patients were transferred by air from outlying stations to the Royal Air Force Hospital, Baghdad.

It was not until 1927 that we started conveying cases by air in Palestine, almost entirely cases from Transjordan across the forbidding mountains of Moab, Jordan Valley and Judean Hills to Ramleh, for admission to the Royal Air Force Hospital at Sarafand. The distance by air to Amman is only 60 miles, but the roads in those days were shockingly bad and really dangerous in wet weather and the aeroplane again proved its worth, and it has now become a matter of routine to convey patients from Amman or Ma'an in Transjordan to hospital in Palestine.

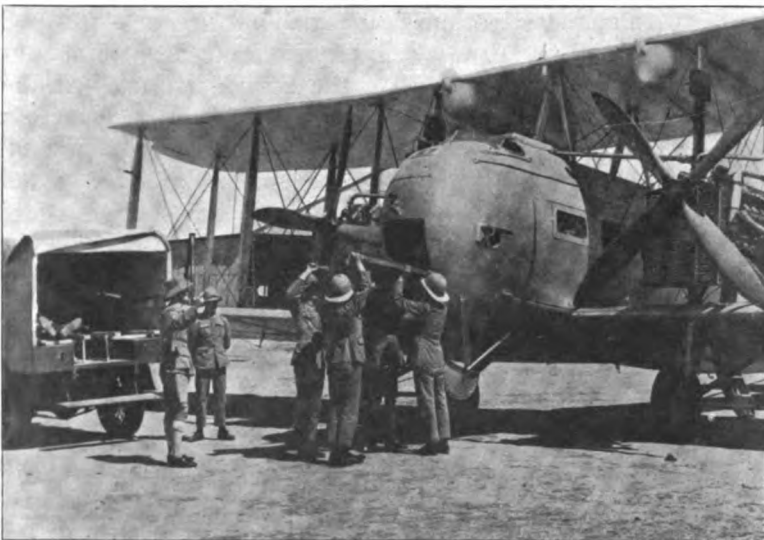
When patients are moved by air it does not mean that on every occasion the aircraft has been specially requisitioned by the medical authorities; on the contrary, the majority of such flights are the result of taking advantage of the presence of an aircraft on some other duty. For instance, a Vickers Victoria made a weekly routine trip from Baghdad to Basrah, another made a weekly trip to Mosul, these aircraft carrying stores, etc., to their destinations; invariably they returned light, so arrangements were made for any sick requiring hospital treatment to be retained and conveyed to Baghdad on the return journey. In the event of urgency a special request for an aeroplane is made by the medical authorities, and my personal experience is that it is always provided, and that in the shortest possible space of time. No precious minutes are wasted in red tape, such as making out requisitions or demands, and these filtering through various departments. In addition to cases of emergency, special machines are periodically requested by the medical authorities to transport batches of invalids; for instance, in Iraq, out of the trooping season, that is, during the hot weather, a number of cases arise which require invaliding to the United Kingdom. The sea passage by packet boat from Basrah is long and tedious and involves transshipment, the invalids are therefore retained in hospital until there is a sufficient number to form a full load for a troop carrier, then a machine is asked for and the invalids flown over to Ramleh for transfer to the Royal Air Force Hospital, Palestine, where they are retained until Headquarters, Royal Air Force Middle East, arrange packet passages to England. A large number of patients are transferred in this way every year.

Any type of case can be carried by air without incurring much risk of



**FIG. 1.—D.H.9. Ambulance used with "Z" Expedition, Somaliland, 1919-20.**  
(Note the hinged top of fuselage to facilitate loading of stretcher.)

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**FIG. 2.—Vickers Victoria. Method of loading a stretcher case through the nose.**  
No ramps are required for this purpose.

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**FIG. 3.—Vickers Victoria. Method of loading a lying case through the door.**  
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**FIG. 4.—Vickers Victoria. Interior of hull showing one stretcher in position.**  
*[Crown Copyright Reserved.]*

aggravation, in fact I personally have never yet met a case in which the flight had any detrimental effect. There seems to be no limitation in this direction. I have known quite a number of cases of acute appendicitis, cases of pulmonary tuberculosis, fractured skull, various other fractures, mental cases, in fact it would be difficult to name any type that has not been carried by air.

As showing what can be done by air transport, I will give you a few specific incidents which will probably bring home to you the value and potentialities of aircraft as vehicles for conveying patients, more particularly when time is the important factor and an appropriate hospital the objective.

(1) In November, 1934, at Hinaidi (Baghdad) we had a short and very sharp epidemic of acute dysentery of the Shiga type; there were ninety-eight cases in ten days, then the epidemic ceased as abruptly as it started, thanks to the fact that we were fortunate enough to put our finger on the source of the trouble in the early stages of the epidemic. Of the ninety-eight cases five died and several were invalided; fortunately it was the beginning of the trooping season and passages were available, but one case caused us a very considerable amount of anxiety. Four times during the period from November to March was this airman put on the D.I. List with no expectation of recovery and four times he defied death; no wonder then that our efforts were concentrated on getting him fit enough to travel to England. We hoped to embark him on the last trooper which left Basrah in March but he was far from being fit enough and as I was particularly anxious that he should travel on a trooper owing to the fact that he would be able to receive appropriate treatment and nursing, which might be difficult in a packet boat, this caused me considerable anxiety. However fortune was on our side and, as the unfortunate patient began to make very slow but steady progress, the D.D.M.S. British Troops in Egypt was communicated with and he was kind enough to agree to reserve a cot on the last trooper which leaves Alexandria, about the middle of April. Now this flimsy wreck of humanity had to be conveyed from Baghdad to Alexandria, a distance of approximately 1,200 miles with the maximum of speed and comfort and the minimum of fatigue and there was only one means by which this could be accomplished. A Vickers Victoria troop carrier was therefore specially requested for the purpose. At dawn two days before the trooper sailed from Alexandria the Victoria took off from Baghdad carrying the patient, a medical officer and nursing orderlies, with appropriate medical supplies and medical comforts so that treatment might be administered *en route* or in the event of a forced landing. My idea was that he should be taken right through to Alexandria in the one day and so enable him to have a much needed rest at our Station Sick Quarters at Aboukir before embarking, but I instructed the medical officer that if on landing at Ramleh to refuel he found any distress whatever in the patient he was on no account to proceed further, but put the patient in the Royal Air Force Hospital, Sarafand, for

the night and continue the journey at dawn the following morning, which would still give him a full day's rest at Aboukir, so I must confess to a little thrill when a signal arrived from the medical officer on arrival at Ramleh saying "patient O.K., proceeding Aboukir to-day" and I was more than delighted when a very reassuring arrival signal came from Aboukir. I am convinced that had it not been for the aeroplane that airman would have long since been dead, whereas he is now alive.

(2) Another flight of interest was when a naval rating requiring hospital treatment was transferred from a naval vessel, operating in the Persian Gulf, to a flying boat and evacuated to the Royal Air Force Hospital, Hinaidi, a distance of approximately 900 miles.

(3) The wireless operator of a survey party working in South Arabia was reported to be dangerously ill. A medical officer was sent by air from Basrah, a distance of approximately 1,050 miles, and the patient was successfully evacuated to Muscat Civil Hospital.

(4) I will give you just one more interesting example. A naval rating at Aden requiring special treatment for a seriously injured eye was conveyed by flying boat from Aden to Port Sudan, where he was transferred to an aircraft of the Middle East Command and taken to Khartoum, a total distance of approximately 1,150 miles, for admission to hospital. The injury was successfully treated and the patient made a satisfactory recovery.

It may interest you to hear that during the twelve-year period, 1925-36 (the last year for which figures are available at the moment) a total of 1,783 patients were carried in Royal Air Force aircraft, while the number of miles covered by these patients is almost astronomical. Take the figures for the year 1935 alone: during that year a total of 282 patients were evacuated by air in 164 flights over 46,995 miles.

The aeroplane is of the utmost value to the medical service in other ways besides the carrying of casualties, for instance, for conveying a medical officer or a specialist to a patient who is not fit to be moved. This has frequently been done in the Royal Air Force, and it has also been done for the Army, and on one occasion a flying boat conveyed two civil surgeons from Singapore to Sumatra at the request of the Dutch Consul General in order to perform a surgical operation on a Dutch Government official. And, of course, you all know of the recent conveyance of three Army nursing sisters by flying boat to Gibraltar to tend the German wounded seamen.

Then we have the tragedy of the Quetta earthquake. During the space of twenty days one medical unit, 15 medical officers, 11 nurses, 12,750 pounds of medical stores and tinned food, 4,300 pounds of clothing, and anti-tetanic serum in considerable quantities, were conveyed by air to Quetta from Risalpur, Peshawar, Kohat, Lahore, Ambala and Karachi.

Three flights of particular interest were (a) in 1935 two **Hart** aircraft flew to Gilgit with plague vaccine for delivery to Kashgar in Chinese Turkestan; (b) in 1936 a private soldier whose recovery depended on rapid

transfer to the hills was flown from Lahore to Chaklala, whence he continued the journey by road; (c) in 1936 two aircraft flew to Kabul with antirabic vaccine which was urgently required.

As this talk primarily concerns the transport of casualties I will mention three occasions which, although the persons transported were hale and hearty, show the possibilities of the aeroplane for evacuating a large number of individuals. Firstly we have the occasion in 1931 when the Northamptonshire Regiment was transported from Moascar, Egypt, to Baghdad when a minor emergency arose in Iraq; secondly, there was the Quetta earthquake when 88 adults and 48 children, a total of 136, were evacuated to Karachi, Lahore and Risalpur. Then we have that classic, the evacuation of the British Ambassador and the entire European Colony from Kabul. Many of you will know that part of the world and will appreciate what those flights meant.

I have given you varied examples of what we have been doing in peace time and I maintain that what can be done in peace can be done in war if the authorities have the will to do it. I have mentioned that during twelve years, 1,783 patients were carried in Royal Air Force aircraft, and I can see no reason why in war, this number of casualties, should not be carried in twelve hours, provided sufficient suitable aircraft are made available for the purpose, and provided suitable landing grounds are available in reasonably close proximity to the casualty clearing station or other medical unit from which it is intended to evacuate casualties; and of course there must be landing grounds at or near the bases where these cases will eventually be off loaded. I cannot see that any complicated organization would be required to effect these evacuations, but it would require a close liaison between the Army and Air Force medical authorities in the field.

Having sketched the possibilities and the practical utility of aircraft as a means of evacuation, let us now briefly apply them to the conditions of war, and for this purpose I think we must divide war into major warfare and minor warfare. Under the former I visualize conditions such as existed on the Western front in the Great War, while under the latter I would place desert warfare and frontier warfare.

To take a major war—here we have a state where the number of pilots and the number of machines available for combatant duties is of vital importance, so much so that it may well dictate the course of the war and I think we can safely assume that the course will be dictated by the force which holds mastery of the air and retains the initiative. In this statement we have the first obstacle to the mass evacuation of casualties.

As aircraft and efficient pilots cannot be turned out at a moment's notice the high command would rightly be most unwilling to divert aircraft for the purpose of carrying casualties while they are required for their prime purpose, which is combatant service, in other words pilots and aircraft could not be spared; for one reason, the greatest number of casualties occurs while a battle is in progress, so if we are going to keep the casualty clearing station

reasonably free from congestion aircraft would be required for the evacuation of cases just when they are most needed for their rightful duties. However, for static or trench warfare, such as was the Western front in the Great War, I will propound what I consider a solution, and I give it to you entirely as my own personal idea. As you know we have squadrons of troop-carrying aircraft; in static warfare there would be no use for them for the carrying of troops, and it is highly unlikely that they would be used as bombers owing to their restricted speed; the only use for them that I can see is the conveyance of urgent material. My idea, therefore, is that these bomber-transport aircraft, as they are called, should be allotted to the medical authorities and used at any point of the front as the situation demands. The pilots and personnel of these "ambulance" squadrons could be used as reinforcements for combatant squadrons, the pilots of these being replaced by pilots who, although physically fit, are battle tired or war weary and in need of a rest and change; there would be no anxiety or strain put upon the pilots as their ambulance duties would consist of straightforward flying from "A" to "B," well behind the lines, with little or no fear of attack from hostile aircraft. I put forward this suggestion for what it is worth, but I can see great possibilities in it.

Here, of course, the Geneva Convention comes into the picture, but one is led to wonder whether much respect is shown for the Red Cross in these modern times, even by so-called civilized races. In any case it is hardly likely that any nation would without question permit of an aeroplane carrying war material forward and casualties back, as it is open to all manner of abuses by an unscrupulous enemy. In my opinion, however, the likelihood of air attack so far behind our lines is comparatively small as the fighters would probably confine their activities to the proximity of the fighting zone or behind their own lines to ward off attack, while a bomber has a definite objective, it would concentrate on the hazardous duty for which it was sent out and would not be tempted to divert from it merely for the purpose of attacking a bomber transport machine down below; the risk to itself would be too great. I therefore do not anticipate any material interference in this way.

Given the aeroplanes and the pilots other factors must be considered. Firstly there is the aerodrome or landing ground, where the patients can be emplaned; this must be within easy reach of the evacuating medical unit if the maximum of speed is to be obtained. It is a matter of simplicity to convey the patients to the landing ground by motor ambulance convoy, and the loading of them into the bomber transport aircraft should take little longer than the loading of motor ambulances with a similar number of cases, but the fear here is attack on the landing ground by long range guns or hostile aircraft. I think it is generally accepted that the next great war will be one primarily fought in the air; it is only natural, therefore, to presume that one of the most important targets will be the aerodromes and landing grounds. Of course landing grounds near medical

units could be reserved entirely for the use of ambulance aeroplanes and never used by any other aircraft, and it could be marked by a distinctive international sign, such as the Geneva Cross, within the normal landing circle ; but here again it is open to such gross abuse that I do not think the Powers would come to an agreement on it. This question of when the landing ground would be safe to use must be left to be decided on the spot as circumstances arise.

Then there is the question of the numbers of casualties for evacuation : in modern warfare the figures are colossal, hence my reason for saying at the beginning of this talk that mass evacuation by air is impracticable. To quote Nicholls again, he makes mention that in one battle the " G " Branch of the staff of one of the armies gave an estimate of 20,000 casualties, preparation was made for 40,000, but the actual number eventually turned out to be 60,000 ; this will show you how utterly hopeless it would be to effect mass evacuation by air and that is why I said earlier on that the aeroplane must only be looked upon as a very valuable addition to the existing means of land and water transport. My " ambulance squadron " of bomber transports could, however, considerably alleviate the congestion at the casualty clearing station, and incidently the anxiety of the authorities, by keeping up a continual stream of evacuation of stretcher cases, more particularly serious and urgent cases. A certain number of walking cases could also be sent by air to make up the full load of the aircraft, but in general such cases would be evacuated by the ground methods.

With the modern mechanization of armies, even major wars are likely to be wars of movement. It is therefore essential that all encumbrances should be removed as early as possible and here, I think, the aeroplane could again prove of value by landing in the vicinity and removing any stretcher cases which may be a source of embarrassment, such cases to be collected at a suitable point adjacent to a landing ground, ready for immediate evacuation.

I will only very briefly mention that in minor wars the circumstances are different, there is unlikely to be any really vital question of superiority in the air, so aircraft are more likely to be available ; in desert or frontier warfare landing grounds are more easily found and there is less likelihood of their being affected by hostile action ; and another important factor is that the number of casualties would reach reasonable figures. Here then the aeroplane would prove of the utmost value in that it could convey the majority of the casualties from the forward areas to a base hospital over some hundreds of miles of difficult country without the necessity of elaborate intermediate medical units. Thus a complicated medical organization is avoided, there is an economy in medical personnel and equipment, and the patient has the advantage of skilled treatment and nursing in proper and suitable environment with the maximum chance of speedy and complete recovery.

The auto-gyro may be suggested as a means of collecting casualties, but

in its present state of development I do not consider this aircraft a practical proposition for the purpose. The auto-gyro could not accommodate a lying case, and as its capacity is limited to one sitting case, I consider that its vulnerability far exceeds its practical utility.

In static warfare the only real value of this aircraft would be to drop down in some forward area to pick up a patient; but in such a case the aircraft being slow and an easy target would draw fire and the result would probably be more casualties than the aircraft went to collect. In desert or frontier warfare, on the other hand, it is conceivable that occasions may arise when this type of aircraft could be usefully employed, but such occasions when a two-seater aircraft could not be used instead are likely to be rare and would not justify the use of the auto-gyro.

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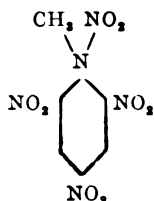
## THE TREATMENT AND PREVENTION OF INDUSTRIAL DISEASES IN FILLING FACTORIES.

By A. L. LEIGH SILVER, M.A.Oxon, L.M.S.S.A.Lond.

*Assistant Medical Officer, Royal Arsenal, Woolwich, Member of Advisory Medical Committee, Industrial Welfare Society.*

### TETRYL.

TRINITRO-PHENYL-METHYL-NITRAMINE, commercially known as tetryl or tetralite, was first described by Romburgh in 1883.



It is a more powerful explosive than trotyl or picric acid, but it is also somewhat more sensitive, without, however, being dangerously so with ordinary precautions. It is suitable for use as an intermediate detonating agent and in conjunction with fulminate is used as a filling for detonators and as a primer for high explosive shells [1].

Pure tetryl looks like flour with faint yellow colour and has a melting point of 129° to 130° C. It is sometimes formed into small pellets with gum or "corned." It has practically no odour but can be "felt" in the nose, giving a "sharp acid" sensation and a tendency to sneeze which, until the nose becomes acclimated, may be troublesome. The chief solvents of tetryl are acetone and benzol, it is only slightly soluble in water, but much more freely soluble in ammonia, giving with the latter a claret coloration.

Staining of the hands in tetryl workers begins in one to three days and the face and scalp become discoloured to a lesser extent in one to three weeks [2]. Sunlight has the effect of deepening the yellow stain and thus during the summer months the term "canary" is appropriate for these workers.

Authorities are agreed that, unlike T.N.T., constitutional symptoms are practically never encountered. Tetryl is a potent source of dermatitis, however, and Ruxton [3] has stated that if precautions are not taken as much as 32 per cent of workers have been affected.

The production of dermatitis, he states, is probably due to two factors : (i) Mechanical—due to the sharpness of the crystals; and (ii) chemical—this may or may not be an oxidising reaction.

The crystals certainly appear very sharp under the microscope, much



sharper than those of T.N.T., but surely if the mechanical factor is to be accepted, trouble would be more frequently found where there is most friction—on the hands, wrists and forearms. Whereas, as we shall see later, it is nearly always encountered primarily on certain areas of the face. These areas correspond to those parts where the sebaceous glands are most numerous and consequently where most sebum is discharged. Of the exposed parts, the middle of the face and the scalp are found to be most rich in these glands, the back of the hands having few and the palms none. It seems probable that tetryl has an affinity for sebum and dissolving in it more readily than in the other excretions of the skin, is able to act as a more powerful irritant in these situations. This theory would explain why workers with greasy skins are more prone to this form of dermatitis. It also explains the fact that research workers are more liable to develop an acute irritation on their hands if, after handling acetone, they touch tetryl before all traces of acetone have been washed off.

Experience has shown that there is no such thing as acquired immunity to tetryl [4]. The only difference between individuals is one of degree; in other words dermatitis may be produced in anyone providing the contact is sufficient. Workers of twenty or more years standing have developed typical tetryl dermatitis for the first time after doing work involving a little extra contact. At the other end of the scale are workers who are peculiarly susceptible to tetryl and in whom contact for a few hours may be sufficient to provoke an attack. Sequeira [5] reports an attack in a susceptible person following travelling in a train with a worker. Men not in direct contact with tetryl frequently develop the typical rash through using the same "shifting room" as tetryl workers and occasionally the workers' wives or other members of the family have developed symptoms.

*Diagnosis.*—The average time for dermatitis to develop is over two weeks. The rash is typical and, unlike T.N.T., practically always affects the face first. The sides of the nose, around the eyes and the corners of the mouth are the sites of election. The earliest symptoms are intense irritation and perhaps a little puffiness around the eyes. Little may be seen except slight reddening and roughness of the skin in these situations. The acute inflammation then becomes more pronounced and may affect in addition the chin, neck and back of the head. Oedema is generally marked, particularly of the eyelids. If untreated this inflammation may lead to a papular eruption which, in its turn, may become infected. Washing and shaving become impossible, and even in the early stages sleep is severely interfered with on account of the irritation. Conjunctivitis is of rare occurrence in healthy eyes. Rhinitis has been reported as a common symptom but I have not found it to give trouble unless there is a concomitant pathological lesion. Occasionally epistaxis, following bouts of vigorous sneezing in those with sensitive noses, may be encountered.

The piquant nature of tetryl tends to produce a healthy appetite and whilst in normal workers the general health may be improved [6], in those

who suffer from dyspepsia their symptoms may be aggravated and they should be removed from this work. Should workers vomit and notice any bile in the vomit they are very liable to suppose that this is tetryl and should be reassured on this point.

A supply of carminative mixture will do much to relieve the occasional stomach pains of healthy workers; they should also be instructed never to start work on an empty stomach.

There are no characteristic changes in the blood, although an occasional increase in the percentage of large lymphocytes has been reported [4].

*Treatment.*—Immediate removal from contact at the earliest suggestion of dermatitis is essential, and care must be taken to see that there is no possibility of indirect or remote contact, for convalescents are found to be unusually susceptible to further attacks.

In mild cases removal from contact is usually sufficient, but some soothing lotion such as *lotio calaminæ* should be given to allay the irritation at night. Oils and ointments in the acute stages are contraindicated<sup>1</sup> and are liable to aggravate the condition. Shaving may have to be suspended for the time and care should be taken to avoid exposing the face to cold winds or to the direct rays of a fire or sunlight. When the acute inflammation has subsided olive oil may be useful for cleansing the affected parts.

If workers recover from an acute attack in under a fortnight, they may be allowed back on contact work on the expiration of a further week, providing full prophylactic measures are taken and they undertake to report back to the surgery at the slightest return of symptoms. A high percentage of these cases never get further trouble, particularly if they are put on work involving less heavy contact.

As with other irritants, tetryl may act as the trigger that releases an attack of generalized eczema or other chronic skin disease. The prognosis and treatment are then altered accordingly. Legally these cases are entitled to compensation for the period of their disability and in the interests of all parties it is important that those likely to develop chronic trouble should be weeded out as far as possible at the preliminary examination and never allowed to come in contact with irritating substances.

*Prophylaxis.*—Shops should be well ventilated and the atmosphere dry.

Workers must be provided with efficient protective clothing which must be changed regularly.

Adequate washing accommodation must be provided and the workers instructed to wash their hands thoroughly in running water before washing their faces. This should be done both before and after work. Soap should be of a good quality, and the addition of five per cent sodium sulphite will convert tetryl into a soluble compound which is more readily washed off.

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<sup>1</sup> Lead lotion is avoided by Smith [6]: "as lead has a dangerous affinity for tetryl." Although I do not recommend this form of treatment, I have never seen any untoward reaction follow its use.

Workers must report at the earliest signs of trouble and the susceptibles "salted out" as soon as possible.

Workers must be warned against attempting to treat themselves with popular proprietary ointments which almost invariably have the effect of irritating the condition.

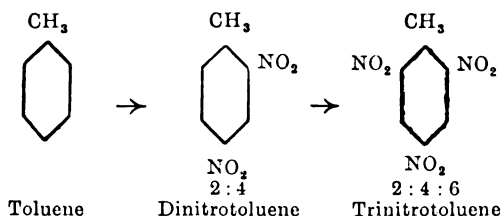
Every effort must be made to prevent the raising of dust. In this respect old workers will be found to be more efficient than new. Safety screens may be used for certain operations.

A water-soluble skin varnish should be used on the face and forearms prior to commencing work.

#### TRINITROTOLUENE (T.N.T., TROTYL, ETC.).

Trinitrotoluene was made in the laboratory by Hepp as long ago as 1880. In 1902 the German military authorities adopted it for filling shells and other countries soon followed suit. It is one of the most stable explosives known; when heated it does not ignite until a temperature of about 300° C. is reached, and even then it does not explode. It has been given many names. In the English service it was formerly known as "T.N.T.", but now as trotyl; in Italy it is called tritolo. Other names are trinol and trilit [1A]. Mixed with ammonium nitrate and other ingredients trotyl forms the basis of many well-known explosives, of which amatol and ammonal may be mentioned.

Trotyl is a pale yellow colour, practically odourless and melts at 81° C. It is soluble in acetone and is obtained from the nitration of toluene (a product of coal tar distillation).



There are six possible isomers, but it is the 2 : 4 : 6 or "symmetrical" variety which constitutes the bulk of crude commercial trotyl.

Although a potent source of dermatitis, prior to 1914 trotyl was generally believed by the experts to be non-toxic. During 1915, however, Dr. E. L. Collis drew attention to the earliest cases of poisoning among trotyl workers, and by the end of the year it had produced fatal jaundice in no less than fifty cases out of many thousands of workers engaged [7].

*Dermatitis* from trotyl is said to be a seasonal complaint, being at its worst during hot weather and at a minimum during the winter. Anything that causes perspiration is to be avoided. Sheds should be well ventilated and the atmosphere dry. Those whose hands perspire freely are particularly liable to develop trouble and they are the first to take the deep orange stain

caused by handling trotyl. It is a common saying among trotyl workers that beer-drinkers are more prone to dermatitis and the same is probably true regarding tea-drinkers and neurotic women. In common with other skin troubles, personal cleanliness, skilled labour and idiosyncrasy all play a large part. With proper protective clothing the first signs of irritation are generally encountered on the hands or forearms. The earliest rash consists of a superficial erythema situated on the ridges of the skin and thin-walled vesicles rapidly form. A particularly characteristic position is between the fingers and at the free edges of the palm. Owing to the thickness of the horny layer in these places a "sago-grain" or "cheiropompholyx" aspect is produced. The irritation is sometimes intense and may interfere with sleep; in severe cases there may be complete exfoliation of the skin of the palms.

Ulcers or "powder holes" on the fingers sometimes occur in workers handling mixtures such as amatol, the hygroscopic property of ammonium nitrate apparently being an important factor in the production of these lesions [8]. I have found them to be extremely rare in men working on pure trotyl.

*Treatment.*—Providing cases are seen in the early stages, removal from contact is generally all that is necessary and recovery is rapid. Care must be taken, however, that the work they are removed to does not entail soiling the hands with some other irritant such as turpentine or paraffin, for they sometimes show a general sensitivity. A few cases proceed to a generalized eczema despite all treatment and the prognosis is then the same as for non-occupational eczema. In order to reduce these cases to a minimum, constant watching and early removal and treatment are essential.

Local treatment is the one in vogue for eczema. In the acute stages the tissues need dehydration, ointments and hypotonic lotions being contraindicated. Alcoholic paints are both theoretically sound and effective in relieving symptoms. They must only be applied under supervision, however, and not too frequently. They should not be used if the epithelium has been removed and the part must not be covered with a waterproof dressing. The following is the formula for pigmentum picric or "T.N.T. Paint," as recommended by Prosser White [2A] :—

℞	Resorcin	..	..	..	3 i
	Spts. ætheris	..	..	..	℥ xx
	Acid carbol.	..	..	..	3 i
	Acid acetic glac.	..	..	..	℥ xx
	Acid salicylic	..	..	..	gr. x
	Tr. benz. simp.	..	..	..	3 ss
	Acid picric.	..	..	..	gr. x
	Isopropyl alcohol	..	..	..	3 i
	Ethyl alcohol	..	..	ad	3 iv

Fiat pig.

In the later stages treatment is the same as for chronic eczema.

*Prophylaxis.*—Gloves are found to be worse than useless for preventing dermatitis. A greater degree of protection can be obtained from the use of a water-soluble skin varnish on the hands and forearms. This varnish must not contain any solvent of trotyl. It must not make the hands "sticky," and if possible it should be colourless. A little should be well rubbed into the skin and allowed to dry thoroughly before commencing work. Magazine clothes must be changed regularly and special attention paid to the fitting at the neck, wrists and ankles.

The greater care spent over skin protection the less likely are toxic symptoms to develop, the skin being the chief channel of absorption. Thus time and money spent on small details are amply recompensed.

*Toxic Jaundice.*—During the war toxic jaundice probably affected 0·2 per cent of all trotyl workers, and of these cases the mortality rate was 25 per cent [9]. In times of peace, when the number of workers engaged and the pressure of work is less, this disease is rare. Nevertheless it is all the more important that the Factory Officer should not be lulled into a false sense of security, for only by keeping a constant watch for toxic symptoms can the early and more amenable cases of this extremely fatal condition be detected.

In 1917 Moore [10] and his co-workers demonstrated the channels of absorption and the methods whereby this absorption could be combated. He proved that the amount of trotyl absorbed from the fumes of the melting pans, and from the dust inhaled in the sheds, is negligible, providing that ventilation is adequate. The important channel of absorption is the skin, and if this can be protected, absorption is reduced to a minimum.

The percentage of cases of jaundice in 1915 with the various explosives was given in an official communication of the Ministry of Munitions [7] as follows :—

Pure trotyl	..	..	27 per cent
Amatol ..	..	..	67 ..
Ammonal	..	..	6 ..

It therefore seems possible that the hygroscopic nature of ammonium nitrate may assist absorption, for amatol contains 40 to 80 per cent ammonium nitrate and ammonal only 20 per cent. This point should be kept in mind in the event of new mixtures being brought out containing hygroscopic salts.

*Diagnosis.*—Trotyl has an action on the blood causing the hæmoglobin to be converted into NO-hæmoglobin and met-hæmoglobin. The result is, therefore, an oxygen dearth. In the early stages the patient appears pale and has ashen-blue lips. There is no true anæmia, however, the red cell count and hæmoglobin percentage are normal, nor may there be at this stage any jaundice. Blood from a prick appears a venous blue colour which does not turn scarlet when exposed to air or when absorbed by blotting paper, and this characteristic, according to Moore, is sufficiently marked for diagnostic purposes.

The symptoms—breathlessness, tightening in the throat and chest,

difficulty in breathing, drowsiness, nausea, abdominal pains, general malaise, appetite stimulated then lost—may not be sufficiently marked for the patient to complain. Jaundice, even of a slight degree, is a late and grave sign and should not be waited for.

Confusion arises sometimes in mistaking dyspeptic symptoms for those of early intoxication. The percentage of workmen as a whole who suffer from dyspepsia is very great and work in contact with trotyl usually makes the symptoms worse and may even "unmask" latent cases of hyperchlorhydria. The trouble is largely due to the hours of work during which the men are unable to partake of a "snack" or of medicine, owing to the rule prohibiting them from taking anything into the danger area. Dyspeptics are best removed from the danger area permanently, as they almost invariably continue to have trouble. Much may be done by instructing men never to start work on an empty stomach and by having a supply of carminative mixture, such as the following, close at hand to allay occasional hunger pains.

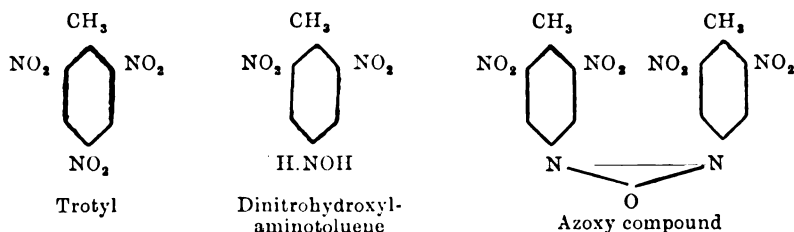
R	Sodium bicarb. ..	..	..	3 ii
	Ol. menth. pip. ..	..	..	℥ xl
	Tinct. zingiberis ..	..	..	3 iiss
	Tinct. card. co. ..	..	..	3 xiii
	Aqua ad ..	..	..	℥ lxxx

Two tablepoonsful to be taken as required.

There is no doubt that if a break of ten to fifteen minutes could be made in the middle of the morning, the general health of the workers would benefit and the output would probably not be lessened. Unfortunately, owing to the isolated positions of danger buildings this is generally impracticable.

It must be remembered that incidental jaundice may arise among trotyl workers. A careful physical examination and history will generally determine the cause, but simple catarrhal jaundice may be extremely difficult to differentiate. The forearms and buttocks should also be examined for the marks of injections; men undergoing courses of arsenical or bismuth preparations rarely state this in their history unless asked a leading question.

*The Fate of Trotyl in the Body.*—As has already been stated the main channel of absorption is through the skin. In the body trotyl is probably converted by a reduction of one of the nitro-groups into dinitrohydroxylaminotoluene.



This is not excreted in the urine as such, but appears as an azoxy

compound in conjugation with glycuronic acid. This azoxy compound can be liberated from the glycuronic acid by treatment with an acid and a colour reaction has been devised by Mr. T. A. Webster for its detection [11].

The interpretation of Webster's test is difficult. The presence of trotyl in the urine is no more indication that the individual is suffering from trotyl intoxication than lead in the urine means that an individual is suffering from lead poisoning.

It has been suggested that the absence of this reaction from the urine of a patient who is known to be absorbing trotyl would be the really ominous sign, but the evidence is so incomplete that no definite statement is justified. All that can be said is that it is a definite indication that trotyl has been or is being absorbed into the body in recognizable quantities.

In addition to excretion in the urine, trotyl is found to be excreted in small amounts through the skin and a red staining on the clothes in the region of the axillæ is occasionally seen, the red colour following the addition of alkali when the clothes are washed.

The post-mortem findings are similar to those from other toxic substances. The disease generally runs a rapid course, the liver shows yellow and red necrosis with great reduction in size and weight. There is infiltration and subsequent fibrosis, resembling ordinary portal cirrhosis, but there is little attempt at regeneration. A case has been reported, however, of death from cirrhosis of the liver in a man who had developed toxic jaundice due to trotyl nineteen years previously. Aplastic anæmia is fortunately a much rarer accident than toxic jaundice, and is sporadic in its distribution. No suggestion is offered for its appearance other than individual susceptibility.

*Treatment.*—This must be prompt, particularly in young workers [7], if a fatal issue is to be avoided, and is carried out on much the same lines as that for toxic jaundice from other causes. Since the War there is some evidence that calcium salts are effective in relieving cases of intoxication due to poisonous substances such as chloroform and carbon tetrachloride [12]. It seems highly probable that cases of trotyl intoxication will benefit from similar treatment, although, owing to the rareness of the condition, it has been impossible to arrive at any conclusion. The patient should be removed to hospital as it is impossible to carry out treatment effectively at home.

He should be given a warm bath and all traces of trotyl removed, if necessary by scrubbing with pledgets of wool soaked in acetone or ether. Special attention should be paid to the hands, nails and scalp.

The bowels must be moved as soon as possible and the urinary secretion and perspiration stimulated by a simple saline mixture.

If the patient is very cyanosed on admission, inhalation of oxygen and carbon dioxide for short periods may relieve the symptoms and perhaps disrupt the NO- and met-hæmoglobin combinations.

The diet should contain fresh vegetables and fruit and be rich in calcium and carbohydrates.

It is suggested that 10 cubic centimetres of 10 per cent calcium gluconate (Sandoz) should be given intravenously on admission, and that intensive calcium medication should be persisted in until improvement is shown.

No patient must ever be allowed back on trotyl.

*Prophylaxis*.—(1) Routine examination of workers for early detection of cyanosis. In addition to this, foremen should be instructed to send any men who appear "off colour" to the surgery, even if they have no symptoms.

(2) Adequate ventilation and control of temperature.

(3) Prevention of skin absorption (a) by the use of machinery where possible; (b) protective clothing; (c) protection of the hands and forearms with a water soluble "varnish." A suitable preparation for this purpose is "Sternocleanse No. 1."

(4) Removal of susceptibles by the "salting out" process.

(5) Alternation of labour. Some figures have been given which appear to show that this is an efficient method. It must be remembered, however, that with double the number of workers the number of susceptibles is also doubled. The workers do not develop the same degree of skill and the output is generally lessened. Also, from a medical point of view, the work of supervising is doubled.

(6) Workers below the age of 18 should not be employed.

*Trotyl Burns*.—An accident of fairly common occurrence among fillers is the splashing of molten trotyl on to the skin of the hands and face and occasionally the conjunctivæ. Trotyl sticks in much the same way as molten sealing-wax and produces superficial burns. I find that these burns do not respond well to treatment with acid preparations such as picric or tannic, but heal rapidly when treated with weak alkalies.

All traces of trotyl are first removed with ether and then a sodium bicarbonate compress is applied for twenty-four hours. If the burn is not severe it is then exposed to the air and washed in ordinary soap and water. If an ultra-violet lamp is available a first degree erythema dose to the area of the burn is found to reduce the pain and to promote rapid healing.

For the eyes, frequent washing with lotio sodii bicarbonatis 3 per cent is found to be effective.

#### FULMINATE OF MERCURY— $\text{Hg}(\text{CNO}_2)$ .

Fulminates of gold and silver have been known for a long time, their discovery being ascribed to Basil Valentine, a fictitious person of the fifteenth century. Fulminate of mercury is now used in the making of detonators and percussion caps [1B].

Workmen exposed to fulminate rarely show the recognized signs of mercurial absorption but they may suffer from dermatitis. In common with other irritants those who perspire freely are more prone to develop



trouble and a spell of warm weather will frequently send up the number of cases. Beginners may show hypersensitivity, but trouble is not commonly met with earlier than the fourth to the fifth day of contact.

**Diagnosis.** The acute inflammation affects the face, neck and post-aural regions, giving as a rule a more blotchy and discoloured appearance than that of tetryl dermatitis. The condition is often associated with conjunctivitis and inflammation of the nose. Although commonly called "fulminate itch" the condition is less irritating and consequently sleep is less disturbed than with tetryl dermatitis. Later red papules form which, if untreated, may become infected. The hands and forearms may be attacked in a like manner and occasionally the fulminate lodging in a crack or abrasion of the skin acts as a corrosive and causes a small circular punched-out ulcer or "powder hole." These necrotic lesions are most commonly found on the tips of the fingers and there is danger of penetration into the joint or down to the bone.

**Treatment.**—Cases should be removed from contact with fulminate and all other irritating substances. For a day or two a solution of sodium hyposulphite 10 per cent freely dabbed on the inflamed area will be found useful, and for the eyes frequent irrigation with sodium hyposulphite 2 per cent solution. Further treatment is then the same as for eczema.

**Prophylaxis.**—Men who suffer from chronic skin, eye, or nose trouble should not be allowed on this type of work. The following ointment smeared on before going into the fulminate room will be found an excellent prophylactic:—

R Two ounces of sodium carbonate in enough water to dissolve it, this to be mixed up with an ounce of anhydrous lanoline.

Fortunately, mercurial absorption is rare, nevertheless a watch should be kept for signs of increased salivation or gingivitis.

I have to thank Colonel J. T. Simson, at whose suggestion this paper was written, and Lieutenant-Colonel W. P. Croker, S.M.O., Royal Arsenal, and Dr. A. Jaques, D.Sc., F.I.C., for criticism and suggestions.

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## THE NEURO-ECTODERMAL DYSTROPHIES.

By MAJOR D. STEWART MIDDLETON, (T.A.),  
Royal Army Medical Corps (T.A.)

Hon. Surgeon, Church of Scotland Deaconess Hospital; Assistant Surgeon, Royal  
Infirmary, Edinburgh.

OF recent years, thanks especially to papers which have appeared in this Journal by MacArthur (1934) and Dixon and Smithers (1935), the important syndrome of acquired epilepsy with multiple subcutaneous nodules produced by cysticercosis or somatic tæniasis has been clearly placed before the profession and especially before those members of it who serve in the Corps. Seen in persons who have served as soldiers or missionaries in India, China or other parts of the globe where infestation with the *Tania solium* is common, there is a natural tendency to look upon an individual who has been abroad and who has developed symptoms of epilepsy along with palpable nodules under the skin as a probable example of cysticercosis. While it is true that cysticercosis is a relatively common cause of such a syndrome, certain cases of the group known as the neuro-ectodermal dystrophies also require consideration in the differential diagnosis. The differentiation of the two is easy provided that the mere existence of the dystrophies be kept in mind.

As an example, may I cite the history of P.B., aged 35, with nine years' service in the 1st K.O.S.B.s. In 1919 he was drafted to India, in 1921 to Egypt, in 1922 to Turkey, and returned home for discharge in 1924 being then in perfect health. In December, 1931, he had a series of convulsions of an epileptiform character and continued to have them at intervals of two or three months until 1934 when he was operated upon by Mr. Norman Dott. A wide skull flap was turned down, and some thickening of the membranes noted. On passing a needle into the lateral ventricle it was felt to traverse some firm areas in the brain substance and especially to penetrate a layer of firm tissue before entering the ventricle.

After this operative exploration the fits diminished in number and severity, and are now more of the nature of *petit mal*.

In 1936 P.B. was admitted for some days to a military hospital, where for the first time the presence of multiple small swellings in the subcutaneous tissues was noted. These swellings had apparently appeared recently and were widely scattered over the surface of the body. Since that time more subcutaneous masses have appeared, and are sometimes slightly tender for a short time afterwards. In no case have the tumours grown to any considerable size. X-ray examination of brain and muscles was negative for calcified cysticerci.

A tentative diagnosis of cysticercosis was made, and since that time the man has had some twenty subcutaneous swellings excised in the vain hope of qualifying for a pension. On every occasion the swellings have exhibited the clinical appearances of small lipomata, and have been proved to be so on microscopic examination.

This appears to be a classical case of tuberosc (potato-like) sclerosis of the brain along with the syndrome of multiple subcutaneous lipomata. The findings at operation of slight meningeal thickening with firm areas of gliosis in the brain are typical as is also the presence of a layer of gliosis around the lateral ventricle. This layer projects into the interior of the ventricle, giving an appearance on section at post-mortem which has been likened to "candle drippings," and may deform the ventricle so seriously as to allow of diagnosis in some cases by ventriculography.

A similar syndrome which might lead to confusion is that of multiple gliomatous tumours on the peripheral nerves, the well-known disease of von Recklinghausen which is not infrequently associated with tuberosc gliosis of the central nervous system.

A short summary of this interesting group of diseases might be of interest to those of us who meet with examples of cysticercosis at intervals.

The neuro-ectodermal dystrophies form a group of degenerative lesions which may affect in one or more manifestations one or more of the portions of the nervous system, that is to say, the central nervous system, the peripheral nerves, the autonomic nervous system, and finally the little understood cells in the skin and probably also in other organs which are only gradually becoming recognized as nervous in origin. Any of the types of degeneration, whether gliomatous, fibrolipomatous, angiomatous, or cystic, may affect the skin, the peripheral nerves, the central or the autonomic nervous system, while more rarely, lesions such as cysts or tumours may occur in the internal viscera. Commonly the degeneration occurs in two or more of these situations.

A general outline of the group may best be obtained by a consideration of the main types which have from time to time been described in the literature. Seven groups can be identified.

(1) Tuberosc sclerosis with mental defect and/or epilepsy. (Bourneville's disease.)

(2) Tuberosc sclerosis with adenoma sebaceum, a syndrome to which the term "epiloia" is commonly applied.

(3) Tuberosc sclerosis with von Recklinghausen's type of neurogliomatosis of the peripheral nervous system, along with cutaneous nævi and molluscum fibrosum.

(4) Tuberosc sclerosis with multiple subcutaneous lipomata.

(5) Tuberosc sclerosis with congenital xeroderma, ichthyosis or hereditary palmo-plantar keratosis.

(6) Angiomatosis of the skin, retina and cerebellum. (Von Hippel-Lindau's disease.)

(7) Cystic degeneration of the central nervous system (syringomyelia) associated with congenital cystic disease of the viscera.

It should be stressed that tuberose sclerosis frequently occurs without peripheral manifestations and that peripheral manifestations are frequent without accompanying tuberose sclerosis. The combination of central and peripheral varieties is, however, sufficiently described to make a connexion between them beyond dispute.

Each of these interesting groups will repay short study.

(1) *Tuberose Sclerosis* (Bourneville's Disease).—This form of cerebral degeneration appears in early childhood and leads to progressive mental defect along with epileptiform seizures in many cases. It may be associated with congenital skin lesions such as ichthyosis, with flat tumours of the retina or fibrolipomatous tumours under the skin of the conjunctiva. The subject of this lesion may be stunted physically, and in one case which has come under my care the dwarfing, which was extreme, was associated with metaphysial bone changes similar to the more severe types of chondrodystrophy.

(2) *Epiloia*.—The syndrome of epiloia consists of central tuberose sclerosis with mental deterioration, epilepsy, etc., along with the development of a peculiar pinkish or red eruption on the cheeks described as "adenoma sebaceum" or Pringle's disease. It is typical of this eruption that it is symmetrically bilateral and has the well-known "butterfly wing" distribution on both cheeks. Little is known of the detailed pathology of the eruption, but the frequency of associated sclerosis of the brain makes it likely that it arises in connexion with nervous structures in the skin.

Flat retinal tumours, also, of course, nervous in origin, are frequently found.

(3) *Tuberose Sclerosis with Von Recklinghausen's Disease*.—Late in last century von Recklinghausen described a syndrome which he called "neurofibromatosis," now perhaps as commonly known as "neurogliomatosis." His cases exhibited multiple tumours upon the peripheral nerves and in the autonomic nervous system, and frequently showed pigmented patches of a nævoid character in the skin or the multiple pedunculated skin tumours called molluscum fibrosum. The correlation between these three features is often so close as to make it likely that both the nævoid patches and the molluscum fibrosum are also of nervous origin. The condition frequently persists throughout life without serious inconvenience to the patient unless an individual glioma grows within a bony canal, as in the optic foramen, causing blindness, on the acoustic nerve within the internal auditory meatus causing the well-known symptoms of a cerebello-pontine angle tumour, or within the spinal canal causing pressure on the cord. In some cases a sarcomatous change may take place in a nodule.

These comparatively common manifestations of von Recklinghausen's disease are well known, but it is not so often recognized that in addition to the skin and peripheral nerves the central nervous system, either the

brain or the spinal cord, may be involved by a patchy gliosis, which, when it affects the brain, may be the cause of epileptiform convulsions.

(4) *Tuberose Sclerosis with Multiple Subcutaneous Lipomata*.—This forms one of the rarest syndromes. Multiple subcutaneous lipomata, making their appearance in adult life, are in themselves uncommon. The tumours bear no relationship to the common solitary lipoma of the outpatient department, for they appear at any time during life, there are many of them, they are frequently a little tender to touch, especially soon after they have appeared, and on excision they often contain a good deal of fibrous tissue as well as fat. In many cases described in the literature the tumours have been symmetrically distributed. Many authors have suggested that this type of lipomatosis was nervous in origin, and that the small fibro-fatty tumours grew upon terminal nerve fibres in the subcutaneous tissues. If this be so the condition has clear relationships to von Recklinghausen's neurogliomatosis. I have encountered one case of an elderly woman suffering from multiple subcutaneous lipomata and epilepsy where the skin over one lipoma was the site of a capillary hæmangioma.

The occasional coexistence of tuberose sclerosis of the central nervous system with multiple subcutaneous lipomata renders the theory of nervous origin even more probable. It is to this group that the case of P. B. which I have described above belongs.

(5) *Tuberose sclerosis with congenital xeroderma, congenital ichthyosis or hereditary palmo-plantar keratosis* has been described. Such cases appear to be very rare.

(6) *Von Hippel-Lindau's Disease*.—The impression is gaining ground that capillary angiomas of the skin may, like the nævoid areas of neurogliomatosis, bear some relationship to the nervous system and may arise in connection with nervous structures in the skin or under nervous influences. Cases may, for instance, be met with where an angioma is strictly limited to the distribution of a given sensory nerve.

The syndrome of von Hippel-Lindau consists of the development of angiomatous cysts of the central nervous system, more commonly in the cerebellum, in an individual exhibiting cutaneous angiomatosis. Angiomatous tumours of the retina may also be present.

(7) The relationship of cystic disease of the various internal organs and of the spinal cord to the group of neuro-ectodermal dystrophies is still slender. On the one hand, however, congenital cystic disease of the kidney, pancreas, liver, or lung has been described along with some of the above well recognized types of neuro-ectodermal degenerations, while on the other, cases are on record of coexistence of cystic disease of these organs with the typical appearances of syringomyelia in the spinal cord. It is possible that, were these lesions more carefully sought for, the coexistence might prove to be more common than is at present suggested, and that a closer study of the two conditions might lead to a wider knowledge of the pathology of both.

The following references will be found of value for those who wish to study the subject in more detail.

My thanks are due to Mr. Norman Dott for permission to make use of his operative findings in the case here described.

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## TERRITORIAL FIELD AMBULANCE TRAINING IN CAMP.

BY BREVET-COLONEL J. KINNEAR, T.D.,

*Royal Army Medical Corps (T.A.)*

SOME seventeen years' experience in a Territorial Field Ambulance enables me to endorse heartily Major J. H. Bayley's criticism of the "usual routine" of Annual Training in camp. For some years now this has been avoided in this unit by endeavouring to make the training as varied as possible and yet preserve its character as Field Ambulance training, which Major Bayley's suggestions, excellent as they are, admittedly do not. A few notes on how this has been carried out may therefore be useful.

Squad drill and stretcher exercises are never indulged in nowadays in camp. The out of camp training season commences with these necessary evils, but, as each man attains the required state of efficiency in the eyes of the P.S.I., he is "passed out" and is no longer required to do them for the rest of the year. We usually, however, have a shot at a ceremonial parade, which is scarcely possible outside of camp, and last year our field ambulance marching past in line was quite creditably performed for our D.D.M.S. after two rehearsals, which did not interfere unduly with other training. Our aim is to get the unit out in the field from the beginning and not to wait till the last few days of camp.

In our recent camps we have been much on our own and combined schemes with other units have not been possible. Two years ago a very successful programme was undertaken covering the whole period of camp, which entailed a fair amount of preparation, but the resulting increase in interest and appreciation by all ranks of what they were trying to do and the valuable lessons they learned made it well worth while.

A small scale map of southern Scotland and northern England was pasted on a wooden board about three feet square and varnished—a necessary precaution, as it is not always dry under canvas! This was hung in the men's canteen. A general war scheme was prepared to cover the whole fortnight and a "news bulletin" affixed daily beside this map on which the front line was indicated by a row of flags on pins moved in accordance with the day's "news." England had made an unprovoked attack on Scotland and for the first week we had to retire. By the second week Scottish mobilization was completed and a sudden attack from the west caused the "invader" in his turn to retire and our forces to make a successful advance. The "war news" had to be written up each evening as the following day's work depended on how things had gone that day; mistakes were made, the weather was sometimes unkind and a day's work

curtailed, and this resulted in the work being repeated, usually on different ground. The scheme could be adapted to the subject of training for the day and still fall in with the "General Situation"; the posting of this daily bulletin was very popular and there always appeared to be a discussion among the troops on its contents, which was doubtless valuable and certainly stimulated their interest.

Our camp that year was at the north end of a range of hills with two diverging roads leading south, one to the east and one to the west of the range. We retreated up the east road during the first week and advanced down the west road the second. Mechanical transport enabled us to start some ten miles from camp, each day's retreat bringing us nearer home, for each day's work began where the previous day's left off.

The first day was devoted to evacuation from R.A.P.'s and at a certain hour the "R.M.O.s" (some represented by N.C.O.s) had to open sealed orders which told them their unit had to retire to a certain line and left them to make their own arrangements and get the information back. Valuable experience was gained in the necessity for rapid but smooth working to get all casualties away in time.

The second day we were evacuating from the retreating column, and, as sometimes happened during the last war, the field ambulance had to fend for itself and a look-out had to be kept for the advancing enemy to avoid capture. The "enemy" were represented by ex-infantry N.C.O.s, who carried signalling flags. They were given certain points to reach at certain times, and if they got within fifty yards of any bearers these were to be considered captured. Wounded were left at various points along the line of retreat and had to be treated and collected; evacuation being, I am afraid, considerably easier than in reality, as there was none of the road congestion one would inevitably get.

The third day we studied particularly running an A.D.S. under similar conditions, and here, as we have invariably found, farmers willingly gave permission for the use of sheds, stables and so on. A rapid clean-up and an official visit of thanks to the farmer before we left kept us on good terms and a return to the same site, if necessary, was always easy. This exercise was repeated further back as rain interfered with its first performance, and it included evacuation of casualties from cavalry patrols on the hills on our flanks. A few "casualties" had been deposited and a message sent in to say where they were and the appropriate measures taken. By the end of the week we were doing M.D.S. work near camp, paying special attention to gas casualties (though our anti-gas equipment was then of the sketchiest) and the keeping of proper records.

The second week started with the enemy being chased from the training area on the hill side in front of camp. Stretcher carriage over rough ground and the proper methods of searching the ground after an advance were the subjects of the day's work. The configuration of the ground also gave us a good opportunity to practise our signalling. We have several



men with a smattering of morse and semaphore, and we aim at having one or two in each company who can read and send simple messages.

Then our advance was deemed to have been held up by the enemy occupying high ground commanding the main road some three or four miles from camp and a brigade to have been detailed to make a flank move and attack the enemy L. of C. behind their position. The collection and evacuation of casualties from this brigade entailed use of circuitous side roads to reach our position, and when word was sent back to the M.D.S. to send up all available transport to evacuate casualties, the civilian lorry driver who took back the orderly with the message disdained the circuitous route on his return journey and led the convoy straight down the main road in full view of the "enemy," and thereby put the whole of our transport "out of action."

The error of those responsible for this regrettable incident having been duly pointed out, the exercise was more successfully repeated as part of next day's programme—our big field day. We always try to have at least one whole day away from camp with every available man on parade. Even the cook-house staffs are included and they have to prepare dinner in the field. The problem of getting hot food to detached posts has to be overcome, and we usually have improvised hay boxes successfully keeping the food really hot while it is being conveyed some two or three miles to the outlying troops.

We had night operations on two occasions. One during the first week devoted to moves by night. Each company was sent away in a lorry to a different destination given by map reference. There they had to "debus" and march to a general rendezvous some three or four miles away. Meantime the lorries had met at a selected spot and in convoy proceeded by a circuitous route to the general rendezvous, where they picked up their companies and returned to camp. It worked very well as all three companies arrived at the rendezvous on time and the convoy was only five minutes late.

The second week's scheme was clearing a battlefield by night, and as we were "under observation from the enemy" no lights of any kind were allowed. The A.D.S. was a realistically ruined cottage and the battlefield rough moorland. At the first attempt hardly any casualties were found, as they hid themselves and "lay doggo." When it was pointed out that had they really been wounded they would have been only too glad to attract the attention of the bearers, the second attempt was more successful and realistic cries came from all over the moor as the dim shapes of the stretcher squads moved about.

I have described this programme in some detail to give an idea of how many aspects of field ambulance work can be tackled in one camp and yet the whole time spent on one scheme which correlated the whole work and made everyone appreciate more clearly where a field ambulance fits in in the general war plan. Naturally it is not possible to organize such a

scheme every year, but even a roughly drawn up idea for a day's work, explained verbally to all ranks before they start, makes a very big difference to the interest taken in it. Nor need it be a tactical scheme at all. Last year we devoted two days to finding out the times taken by squads per round trip under varying conditions and over different distances. The bearers themselves were as interested as we were in seeing how this worked out, and the general conclusion was that the official figures are much too high.

One could go on for much longer describing attempts to vary the camp programme. For instance, the problem of co-operation with the infantry which I have so far not successfully solved. I should like to get real co-operation, so that when an umpire tells an infantry company, for instance, that it has suffered so many casualties, these would be treated as casualties and evacuated to and by the field ambulance. With 75 per cent walking wounded up to the A.D.S. it should not be too difficult nor disorganize the infantry scheme. In fact it should help considerably to bring home to them the effect of faulty tactics, as well as to demonstrate as closely as peace conditions permit what actually happens to the wounded. A few men earmarked as casualties beforehand and told when they have to fall out is no real co-operation, and the lessons learned are of no more value than when the field ambulance is on its own and of no value at all to the infantry.

I have written enough, however, to show how strongly I support Major Bayley's plea to get away from the spirit-destroying monotony of the same routine each camp, and especially from wasting valuable time in squad drill and stretcher exercises at camp. By the time the field ambulance goes into annual training it should have passed that stage and be ready to proceed at once to the much more interesting duty of practising all its functions, as nearly as fact and imagination can make it, under the conditions it would actually find in war time.

I cannot finish without expressing my great appreciation of the very loyal and whole-hearted co-operation of our various adjutants, especially Major F. M. Richardson, R.A.M.C., who was associated in the various schemes described above and whose many suggestions and assistance made the training the success it was.

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## PROTEUS MUAR ISOLATED FROM A MOUSE.

By MAJOR G. T. L. ARCHER,  
*Royal Army Medical Corps.*

*Proteus muar* was first described by Martin (1931). It was originally isolated from the pus from an empyema and is of interest as its "O" antigen is the same as that of *Proteus* XK while the "H" antigen differs from that common to the "X" strains.

The organism now to be described was isolated in the Vaccine Department of the Royal Army Medical College from the heart's blood of a mouse which was being examined post-mortem in the course of routine tests on the virulence of enteric organisms.

### BIOCHEMICAL REACTIONS.

The biochemical reactions of the isolated organism (hereinafter referred to as *Proteus* "mouse") were as follows:—

Lactose	Glucose	Mannite	Saccharose	Dulcite	Maltose	Milk
—	A.G.	—	A (late)	—	—	Alk. indol.

They resemble those of *Proteus vulgaris*, and *Proteus* XK and differ from those of *Proteus* X19, X2 and XL.

### SEROLOGICAL REACTIONS.

An alcoholized suspension of *Proteus* "mouse" was agglutinated by OXK serum but not by OX19 or OX2 serums. A formolized suspension of this organism was not agglutinated by HX19 or HX2 serum. This suggested that the organism was either related to or identical with *Proteus muar*.

Complete identity would appear to be established by the results of cross agglutination and absorption tests carried out with the isolated organism, a subculture of *Proteus muar* obtained from the Lister Institute, and serums prepared from each, shown in Table I.

Furthermore cross absorption of OXK and *Proteus* "mouse" serum with OXK and *Proteus* "mouse" suspensions showed that, as shown for *Proteus muar* by Martin and confirmed by Felix (1933), the "O" antigens of these strains are identical.

The "H" antigen was now examined. Suspensions of HX19, HXL, HXK, *Proteus vulgaris* strains 3156, 402, 4199, 2100 (received from the Lister Institute), "G" (received from Major W. F. Lane, R.A.M.C.) and 384 (isolated from another mouse under similar circumstances to those in which the organism under investigation was found) and serums prepared against "mouse," muar, 384 and HX19, were used.

Results are recorded in Table II.

TABLE I.

Serum	Absorbing organism	Dose	Suspension				
			OXK	Mouse H	Mouse O	Muar H	Muar O
Muar ..			$\frac{1}{2,500}$ tr.	$\frac{1}{5,000}$	$\frac{1}{500}$	$\frac{1}{5,000}$	$\frac{1}{500}$
Muar ..	"Mouse" H	"Full" "Half"				0 $\frac{1}{50}$	0 0
		Dose expressed in thousand millions per c.c. of serum					
Muar ..	"Mouse" O	250 100 25 0 (control)	$\frac{1}{50}$ $\frac{1}{125}$ $\frac{1}{125}$ $\frac{1}{2,500}$			$\frac{1}{5,000}$ tr. $\frac{1}{5,000}$ tr. $\frac{1}{5,000}$ $\frac{1}{5,000}$	0 $\frac{1}{50}$ $\frac{1}{125}$ $\frac{1}{500}$ tr.
"Mouse" ..			$\frac{1}{1,000}$	$\frac{1}{10,000}$	$\frac{1}{2,000}$ tr.	$\frac{1}{5,600}$	$\frac{1}{500}$ tr.
"Mouse" ..	Muar H	120 60		0 $\frac{1}{125}$	$\frac{1}{50}$ tr. $\frac{1}{50}$		
Mouse ..	Muar O	200 120 60 0 (control)	$\frac{1}{50}$ tr. $\frac{1}{2,500}$ $\frac{1}{2,500}$ $\frac{1}{10,000}$ tr.	$\frac{1}{2,500}$ tr. $\frac{1}{2,500}$ $\frac{1}{2,500}$ $\frac{1}{10,000}$ tr.	$\frac{1}{50}$ tr. $\frac{1}{50}$ tr. $\frac{1}{500}$		

TABLE II.

Serum	H Suspension									
	HX19	HXK	HXL	G	3156	402	4199	2100	Mouse	384
Mouse	$\frac{1}{100}$	$\frac{1}{100}$	$\frac{1}{250}$	$\frac{1}{250}$ tr.	$\frac{1}{250}$ tr.	$\frac{1}{5,000}$	$\frac{1}{5,000}$ tr.	$\frac{1}{125}$	$\frac{1}{10,000}$ tr.	$\frac{1}{10,000}$ tr.
Muar	$\frac{1}{25}$	$\frac{1}{125}$	$\frac{1}{25}$	$\frac{1}{250}$	$\frac{1}{50}$	$\frac{1}{5,000} +$	$\frac{1}{5,000} +$	$\frac{1}{250}$	$\frac{1}{5,000} +$	
384	0	$\frac{1}{25}$ tr.	$\frac{1}{50}$ tr.	$\frac{1}{50}$ tr.	$\frac{1}{125}$ tr.	$\frac{1}{2,500}$	$\frac{1}{2,500}$	$\frac{1}{25}$	$\frac{1}{2,500}$	$\frac{1}{2,500}$
HX19				$\frac{1}{5,000}$ tr.	$\frac{1}{25}$	$\frac{1}{250}$ tr.	$\frac{1}{50}$	$\frac{1}{5,000}$		

They suggest that three specific "H" antigens are represented in the strains used, one common to the "X" strains "G" and 2100, another common to "mouse," 384, 402, and 4199, and a third occurring in 3156, while subsidiary group antigens are also present.

Final absorption tests showed that 4190H absorbed all the homologous agglutinins from 384 serum and the "H" but not the "O" agglutinins from muar serum, while no absorption occurred when 384 serum was saturated with muar "H," or when muar or "mouse" serum was saturated with 4199 "O."

#### CONCLUSION.

An organism isolated post-mortem from the heart's blood of a mouse has been shown to be *Proteus muar*. The muar "H" antigen is identical with that present in three of six strains of *Proteus vulgaris* examined.

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## Editorial.

### INFLUENZA.

A STUDY of epidemic influenza in 1936-37 has been made by C. H. Stuart Harris, C. H. Andrewes and Wilson Smith, with the object of demarcating cases of influenza of virus origin from other diseases with similar symptoms. Correlated, clinical and laboratory studies were begun in 1936, Stuart Harris being responsible for the clinical investigations and Andrewes and Wilson Smith for the experimental side of the work.

Early in February, 1936, outbreaks of respiratory disease resembling influenza were studied at Woolwich, at Eastchurch in May, 1936, at Chatham in November, 1936, and at Rugby School in the same month. The influenza virus was not isolated in any of these outbreaks and the causal organism could not be discovered, but there was some evidence that hæmolytic streptococci were concerned both primarily and secondarily. The clinical evidence supported the view that there is a disease different in ætiology from epidemic influenza and characterized by an attack on both upper and lower parts of the respiratory tract. The disease was more catarrhal in nature than epidemic influenza and there was more marked laryngitis and tracheitis. The fauces showed more inflammation of the tonsils, frequently with exudate, so that confusion arose with follicular tonsillitis of streptococcal origin.

Clinical studies were made on 120 patients during the widespread epidemic of influenza from December, 1936, to February, 1937. Study of the epidemic began at the Royal Air Force Depot, Uxbridge, and at the Household Cavalry Hospital, Windsor. Then at Chatham, the patients being studied in the Royal Naval Hospital, and continued at the Military Hospital, Shorncliffe. The object of studying the epidemic in a number of areas was two fold: firstly, to observe as many cases as possible during the limited period of time of an epidemic, and secondly to avoid error in the delineation of the clinical picture because of variations in the severity of the epidemic in different localities.

The patients were described under three headings: (1) simple influenza (86 patients), (2) influenza with bronchiolitis, (3) pneumonia.

The simple influenza group consisted for the most part of cases of a short febrile illness varying in severity, but presenting a remarkably uniform picture on the whole. After feeling quite well in the morning the patient was seized with headache, felt ill, and began to shiver in the afternoon. He had a restless night with headache and aching in the limbs and back, and developed a short dry cough. The next morning there was pyrexia reaching 102° to 103° F. during the day. The disease was now at its height, the patient's face was flushed, nose obstructed, tongue coated

with white fur; the throat was injected without exudate and with but slight soreness. On the third day there was great improvement, with loss of the facial flush, and temperature only slightly above normal. But on the morning of the fourth day pyrexia was renewed with a return of the headache and an increase of the cough with a small amount of mucopurulent sputum. The face was again flushed, the throat injected, with fine granularities and enlarged nodules on the posterior pharyngeal wall, while rhonchi were heard over the bases of the lungs. The symptoms usually abated in the evening and on the morning of the fifth day the temperature fell to normal. The patient was now quite well, except for weakness and a slight cough. He could generally be discharged from hospital on the ninth day. There were no sequelæ as a rule.

The evidence that the typical case of influenza just described was a case of influenza is based on the recovery of the virus from ten out of thirteen patients whose garglings were tested on ferrets.

A great variation was seen in the type of the fever. Some 23 per cent showed a chart with two dominant peaks and a much lower, or normal, in between (like the saddle-back chart seen in Indian cases of pyrexia). This type of fever is interesting as it resembles the type seen in ferrets experimentally infected with influenza virus.

In some of the patients there were signs that the inflammatory process had extended beyond the bronchi and the chest signs dominated the picture. These cases have been called influenza with "bronchiolitis." There was no doubt that they were cases of influenza for the virus was recovered from five of the cases whose garglings or sputum was tested on ferrets. There was a suggestion from the combined evidence of clinical and radiological examinations that the process involved the alveoli as well as the bronchioles.

There appear to have been two types of the condition: in one type the patient had a severe attack and signs in the lungs appeared in a day or two; in the other type the case was not necessarily severe but the patient had one or more relapses when the physical signs in the chest became apparent. The virus might be recovered during the initial symptoms, but could not be recovered during the relapse.

A study of the history of the cases did not indicate that previous disease of the respiratory tract had been lighted up. It seemed likely that the chest condition was characteristic of the infection itself, namely, influenza.

With regard to the cases with relapses, the fact that the virus was only isolated from garglings during the initial illness would suggest that the influenzal infection had paved the way for a secondary infection which gave rise to the chest condition. But the long-continued signs in the chest seen in the relapsing type of case might be explained by a slow repair of an inflammatory process in the bronchioles; during this stage secondary infections might occur leading to a prolongation of the process.

The cases in the third group which developed pneumonia were difficult

to analyse because of their individual variations. The evidence from the pathological side was difficult to interpret.

Of the two patients from which the virus was recovered, one, seen at the Hammersmith Hospital, was rapidly fatal and from the lung the virus and *Staphylococcus aureus* was recovered. Three other similar cases are known to have occurred in two other London hospitals, and from the lungs of two cases influenza virus and a pure culture of staphylococcus were recovered at Hampstead. The clinical course of each case was a fulminating pneumonia similar in type to that seen so commonly in 1918.

The second case seen by the authors of this report at Uxbridge was a typical influenza pneumonia. Yet the consolidation of the lungs was lobar in type and the illness terminated by crisis on the tenth day.

The remaining patients with pneumonia formed a heterogeneous group, and these were classed under four headings: (1) Typical influenza pneumonia; (2) abortive pneumonia; (3) post-influenzal pneumonia; and (4) miscellaneous group.

In the discussion on the pneumonia cases it is stated that at least three groups of patients with signs of consolidation of the lungs could be distinguished during the epidemic. These were the fulminating, the influenzal and post-influenzal pneumonias. The fulminating cases appeared to be merely extreme examples of the influenzal type of pneumonia, from which they differed only in having an extremely rapid course. The influenzal type was clinically different from the types of broncho-pneumonia and lobar pneumonia which are endemic in this country and occur unrelated to an influenza epidemic. The aspect of the patient was that of influenza—there were nasal and faucial signs and symptoms, dyspnoea was not noticeable in spite of the raised respiratory rate, the signs in the chest approximated to those of bronchiolitis, though a frank lobar pneumonia might develop; the sputum in the early stages was frothy and not rusty or viscid. The post-influenzal pneumonias resembled pneumococcal pneumonia much more than the influenzal group. The illness was sudden, with pain in the chest or a rigor; upper respiratory catarrh was absent, with lack of coryza or pharyngitis; the fever often ended with crises; the signs in the chest were those of lobar consolidation; the sputum was often rusty and viscid. The only difference from classical pneumococcal pneumonia was the absence of dyspnoea, although this occurred when pleurisy developed.

The object of the research being to correlate physical signs and symptoms with isolation of the influenza virus, the authors think that differentiation of the virus disease in the 1936-37 outbreak appeared feasible if attention was paid to certain definite features to which attention has already been drawn. In contrast to the description given of cases associated with the virus, febrile catarrhs have an insidious incidence, respiratory symptoms and sore throat and cough dominate the picture; the cough is irritating and painful, and the appearance is that of a patient with a heavy



cold. The fever has no definite course and is not diphasic. The physical signs are obstructed nose, hoarse voice and signs of tonsillitis or pharyngitis. Chest complications are common and comprise bronchitis of large or small tubes and broncho-pneumonia. The hæmolytic streptococcus is a common excitant of the chest complications.

So far as epidemic influenza is concerned, no single symptom or sign is diagnostic. If full range of clinical events is taken into account, and if the patient is viewed in relation to the disease in his immediate contacts, then differential diagnosis of the two conditions is considered possible. In the case of a single isolated patient caution should be exercised in the diagnosis of influenza unless he presents the typical picture just described. It is recognized, however, that in a widespread epidemic many minor variations of the typical picture of influenza are likely to occur.

The laboratory investigations which were made in parallel with the clinical observations have yielded information of great interest. Influenza virus pathogenic for ferrets was recovered from a high proportion of typical cases of influenza during the epidemic of 1936-37. The strains of virus appear to be very similar to those obtained in previous years in this country and other parts of the world, because they are all neutralized by the standard hyper-immune horse serum and they cannot be distinguished by means of cross-immunity tests in ferrets.

Although the viruses are closely related recent studies have shown that different strains occur, as was first pointed out by Francis and Magill, and the study of the 1937 strains has made it clear that these show differences from those obtained in previous years and also that all the 1937 strains are not identical. It is not known how many strains there are : it is a slow and tedious task to analyse the whole group.

Virus was not obtained from cases of febrile catarrh, which resembled influenza to some extent in symptomatology.

Wilson Smith, C. H. Andrewes and C. H. Stuart-Harris studied the immunization of human volunteers. Francis and Magill, using living culture virus, inoculated volunteers, either subcutaneously or intradermally, with three doses at weekly intervals. In the second week there was an abrupt anti-body increase in all the volunteers except one ; a high increase was maintained for two months, but after five months some decline was evident. Andrewes and Smith found a similar stimulation of antibodies by the intramuscular injections of a single or double dose of formalized mouse lung virus. Stokes claimed to have reduced the incidence of influenza in volunteers by intramuscular injection of living mouse virus. All workers are agreed that vaccination with either culture or mouse lung virus, living or formalin inactivated, produces no undesirable reaction.

Much work was done by the authors on the antibody content of human sera, as measured by the passage strain (W.S.), before they became aware that several strains of virus existed. However, it seems clear that the general level of neutralizing antibodies from the strain W.S. fell in the

general population to a fairly low level by the end of 1936. It appears that neutralizing antibodies to W.S. may develop in patients who suffer from infection with one of the kindred strains. This is not surprising, as experiments with a hyper-immune horse serum show that there is some common factor in all the strains so far studied. Indeed, there is evidence that antibodies to swine influenza may develop after infection with the human strains of the virus. There is also evidence that antibodies may develop in influenza contacts who themselves show no signs of the disease. No proof has been obtained that there is any relationship between the level of W.S. antibodies in human sera and susceptibility to infection during the last epidemic.

Experiments on the immunization of ferrets against the strain W.S. have shown that it is not possible to immunize normal ferrets completely against massive test doses of virus, yet it is possible to render them sufficiently resistant to withstand the milder test of contact infection with the same strain of virus.

Numerous tests showed that the resistance of a ferret to infection with W.S. strain is measurable, roughly by the virus-neutralizing potency of the serum. These observations are encouraging and their application to man is self-evident.

Unfortunately, Francis and Magill's observations that all strains are not identical has been confirmed and extended. Cross-immunity experiments show that although vaccination of mice with one strain will render them resistant to that strain, they are only partially resistant to a different one. Moreover, the virus-neutralizing potency of a serum, though a measure of a ferret's resistance to the homologous virus, does not measure, even crudely, the resistance to a heterologous strain.

By the beginning of November, 1936, the results of experiments with ferrets appeared to justify a large scale trial of the efficacy of human vaccination. The plan of this experiment was to obtain groups, each of 200 volunteers, situated in widely separated localities. Apart from the staffs of the Medical Research Institute and the Farm Laboratories, all volunteers belonged to Army units. In some groups half the men were inoculated and half kept as controls ; in other Army units all the volunteers were inoculated, the remaining men on the strength being regarded as controls. Formolized W.S. vaccines were employed.

Unfortunately, the epidemic appeared at Uxbridge in the middle of December before sufficient vaccine had been prepared. The tests, however, were proceeded with. It was hoped that some districts would escape until some time after the vaccine had been given to the volunteers. This hope was not realized. The case incidence was far too low to be of much value. In every group, except one, cases occurred either before or two or three days after vaccination. In Woolwich, where vaccination had been completed some time previously, not a case occurred in either inoculated or control groups.

Vaccination does not produce antibody response until some time in the second week, and cases should not therefore be judged until fourteen days after inoculation. Garglings were taken from eight out of ten cases occurring after fourteen days and tested by ferret inoculation. Virus was recovered from four of the cases, so that vaccination was not completely successful in protecting against epidemic influenza of virus origin. Almost all the virus strains recovered in the last epidemic show differences from the W.S. strain and the only strain recovered from a vaccinated subject and thoroughly studied is certainly not identical with it.

It was clear that the possibility, or otherwise, of successful vaccination of man had not been tested properly.

Much of the work recorded in the Report was done with the original W.S. virus before it was recognized that varieties of influenza virus existed.

It is clear that all the viruses have some common factor and it is thought that the differences, so far as present information is available, are not so great as is the case with certain other viruses, such as the three strains of foot-and-mouth disease. The differences, however, may be so great as to influence a vaccination experiment unfavourably.

There are indications that strains overlap considerably, and it is thought possible that a strain exists which will cover all types sufficiently well to render immunization with mixed vaccines, or successive inoculations made from three or four strains, unnecessary.



## Clinical and other Notes.

### OTITIC HYDROCEPHALUS: A CASE RECORD.

BY MAJOR J. BENNET,  
*Royal Army Medical Corps.*

It is now well recognized that the course of suppurative otitis media may be complicated by signs of increased intracranial pressure which do not necessarily indicate the existence of a localized lesion requiring drainage by surgical methods. Some of the features presented by such cases may be alarming if the possibility of explaining them on the basis of a relatively benign underlying condition is not borne in mind. In a review in 1931 Symonds [1] did much to clarify the subject, which had previously been somewhat ill-defined. In the same work this writer described, under the name "otitic hydrocephalus," cases in which signs of increased intracranial pressure complicated the course of middle ear suppuration, and in which these did not result from suppurative complications calling for surgical drainage. He indicated that this name avoided any connotation of active inflammation and was non-committal as an indication of the site of the accumulation of fluid, i.e. in the subarachnoid space or the ventricles.

At a recent meeting of the Section of Oto-rhino-laryngology of the British Medical Association, McConnell [3] described the derangements of the cerebrospinal fluid following otitis media as of two general types: (1) Those in which the amount is excessive, the "otitic hydrocephalus" of Symonds; and (2) those in which there is a derangement in the circulation of the fluid rather than of its amount. In these there is an obstruction at some situation in the course of the circulation of the fluid, i.e. at the outlet from the ventricles, or in one or more of the cisterns of the posterior fossa. In such cases the collection of fluid is localized in the ventricles or the cisterns.

The pathology underlying otitic hydrocephalus is uncertain. As the condition is usually benign post-mortem records are few. In a description of the same condition in 1930, under the name "arachnoiditis (serous meningitis)" Cairns [4] mentioned that the term "arachnoiditis" which he used was probably misleading, as in one case which had been examined at autopsy there was no evidence of inflammation of the arachnoidea. In the same communication this writer stated that the condition is usually associated with acute or chronic mastoiditis, especially when the labyrinth is involved. It has been suggested that lateral sinus thrombosis, complete or partial, may occur more commonly in the course of suppurative otitis media than surgical records indicate, as in some cases the condition may not progress to a full-blown suppurative thrombo-phlebitis. A study of

the cases of otitic hydrocephalus recorded shows that there has been some evidence of disease of the dura covering the lateral sinus in a considerable number, although in many of these the sinus has bled freely when opened at operation. Lateral sinus thrombosis was present, although in one case it was only partial, and was treated surgically in all of a series of three cases described by Symonds [2]. This writer, however, states that the association of otitic hydrocephalus with a complete lateral sinus thrombosis is inconstant.

The clinical features of otitic hydrocephalus as established by Symonds are as follows :—

The condition is usually found in children or adolescents. It may occur in the course of acute or chronic otitis media with or without mastoiditis, lateral sinus thrombosis, extradural abscess, labyrinthitis or meningitis. The cases almost invariably complain of intermittent headache. Nausea and vomiting are less constant symptoms. In the fully developed state the temperature and pulse are normal. Mental functions may be clouded or clear. Papilloedema is a constant feature, and this may progress to secondary optic atrophy in cases showing comparatively mild and infrequent headache without the supervention of other symptoms or signs of importance. Signs of paresis of the 6th nerve on the affected side may occur. The development of the condition may or may not be preceded by pyrexia and signs, such as neck rigidity, indicative of a preliminary meningitis. The cerebrospinal fluid is under greatly increased pressure but shows no excess of cells or of protein. In cases preceded by signs of meningitis, however, examination of the fluid at this stage may show an increase in these constituents. The course may run into weeks or months, and in many cases there is a tendency towards spontaneous recovery. The papilloedema, however, may advance to secondary optic atrophy. On this account the persistence of intermittent headache and papilloedema call for active treatment by lumbar puncture repeated at intervals until symptoms disappear and the manometer indicates a normal pressure. The suppurative complications of otitis media, if present, call for the usual methods of surgical treatment, but otitic hydrocephalus as a complication *per se* is no indication for intracranial surgical exploration.

Symonds sets forth clearly the features which enable a differential diagnosis to be made between otitic hydrocephalus and cerebral abscess. As headache, vomiting and papilloedema are common to both conditions, this may require careful consideration. The points on which he lays stress are the following :—

(1) *The Degree of Papilloedema.*—This is severe in otitic hydrocephalus, usually amounting to several dioptries of exudate with hæmorrhages. In abscess it is mild, being often represented merely by mild venous engorgement. In the exceptional cases of abscess which show a severe degree of papilloedema this is usually associated clinically with drowsiness.

(2) *The General Clinical Condition.*—In otitic hydrocephalus the

patient in the periods of remission of headache is alert and lively. In cerebral abscess signs of toxæmia colour the clinical picture more continuously.

(3) *Localizing Signs*.—An abscess in the cerebellum or in the left temporal lobe will usually give rise to localizing signs before those of increased intracranial pressure are evident. In the case of the cerebellar lesion there will be nystagmus towards the affected side and inco-ordination in the use of the upper limb on the same side. In abscess of the left temporal lobe there will be an inability to recall names in a right-handed person, and, possibly, weakness of the opposite side of the face and a homonymus defect of the opposite visual field. An abscess of the right temporal lobe is, however, frequently silent.

(4) *The Cerebrospinal Fluid*.—In otitic hydrocephalus the pressure is high, usually in the region of 300 millimetres water or above this. The fluid is normal, i.e. contains no excess of cells or of protein. In cerebral abscess the pressure is not so high. Taking the normal pressure as 150 millimetres water, pressures between this level and 250 millimetres are usually found. Moreover, in the latter condition the fluid is never normal microscopically and chemically. A slight excess of cells, mainly lymphocytes with a few polymorphs, is usually present, and the protein is always increased.

*Case*.—Male ; aged 23. *Acute suppurative otitis media, right (hæmolytic streptococcus infection). Persistence despite drainage. Mastoiditis ; cortical mastoid operation. Persistence of fever with hæmoptysis and evidence of acute focal nephritis. Retrosternal abscess (hæmolytic streptococcus infection). Jugular vein tied and retrosternal abscess drained. Subsidence of fever. Persistent paroxysmal headache and increasing papillædema.*

April 26, 1937 : Admitted to hospital with a history of discharge from the right ear of three days' duration.

May 11 : As the middle ear was not draining satisfactorily through the small perforation this was enlarged by an extensive paracentesis.

May 14 : Discharged to attend as an out-patient.

May 19 : Readmitted to hospital as the discharge was not lessening in quantity despite the usual meatal treatment. Temperature normal. Patient remained well apart from a profuse aural discharge for five days.

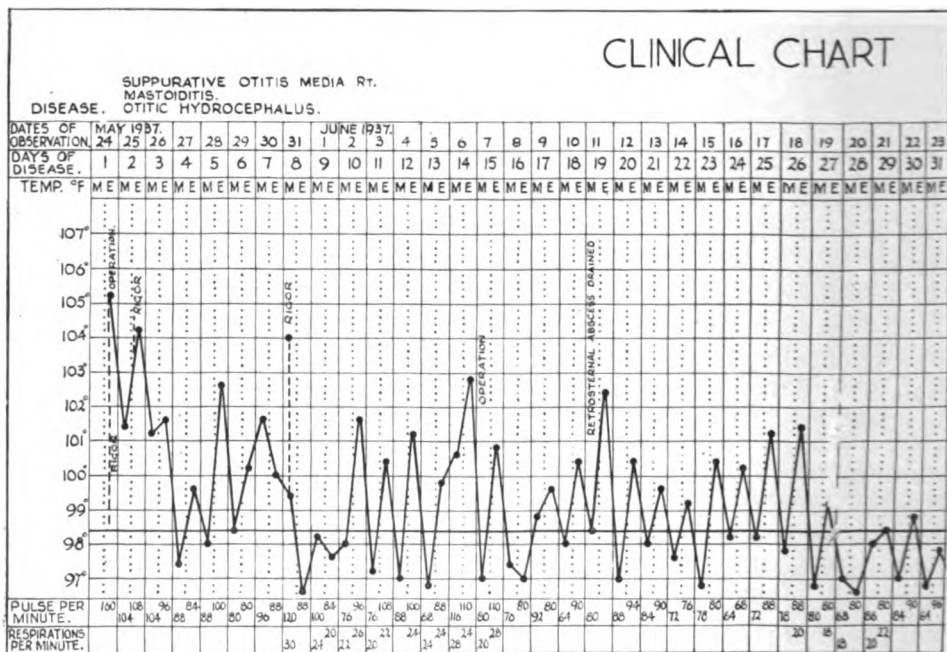
May 24 : Suddenly developed severe generalized headache, a rigor and vomited twice. The temperature rose to 105° F. and the pulse-rate to 160. There was no mastoid tenderness. Lumbar puncture showed a fluid under pressure, but normal as to cell count, protein and sugar content and sterile on culture. A cortical mastoid operation was performed, and pus was found in the mastoid antrum and cells in immediate relationship. The tip cell was healthy, and there was no evidence of spread towards the lateral sinus or the middle fossa of the skull.

May 25 : A number of slight rigors occurred. The patient perspired

profusely and complained of headache. A period of irregularly intermittent fever followed (see chart).

May 30 : Cough and scanty bright red blood-stained sputum. Examination of the chest showed no abnormal physical signs.

May 31 to June 3: Temperature intermittent. Patient vomited six times during this period, complained of headache, and he had a rigor on June 1, the temperature rising to 104° F., the pulse-rate to 120.



June 4 : An inflammatory swelling was observed on the right border of the sternum. The general condition was that of a septic state, with furred tongue, profuse sweats and intermittent fever ranging from 97° to 102° F. There was a slight cough, but nothing abnormal was found on examination of the chest except the inflammatory lesion. A radiogram of the chest showed no abnormal appearances. No abnormal physical signs were found on examination of the nervous system, and there was no papillœdema on this date. The urine, which had hitherto been normal, showed acid reaction, specific gravity 1020, a trace of protein and sugar, numerous red blood-cells present singly and in clusters and a few leucocytes. Leucocyte count, 11,400 per cubic millimetre ; polymorphs, 65 per cent ; lymphocytes, small 20 per cent, large 8 per cent ; large hyaline cells, 7 per cent.

June 7 : Inflammatory swelling on the chest wall (retrosternal subperiosteal abscess) aspirated and pus withdrawn from which a hæmolytic streptococcus was grown. Cranial nerve functions normal. No papillœdema. Mastoid wound reopened and found healthy. Exposure of the

lateral sinus showed a little liquid pus in the region of the bulb only. Sinus wall grey and unhealthy looking. The sinus was opened and bled freely. The jugular vein was exposed in the neck and tied.

June 8: The patient vomited, and the temperature, after having been normal for twenty-four hours, commenced to rise again.

June 11: Operation on the chest wall: retrosternal abscess drained.

June 14: Temperature intermittent, but swinging less than before. Leucocyte count: 14,200 per cubic centimetre; polymorphs, 78 per cent. Examination showed about two dioptries of papillœdema in each eye, the left being slightly more swollen than the right. Urine normal.

Administration of sulphonamide one gramme thrice daily commenced.

June 15: Attack of severe headache associated with vomiting. Slight apparent confusion as to place and surroundings.

June 16: Patient appeared to be very ill; complained of severe headache and was very pale. Pulse rate 64.

June 17 to 19: Paroxysms of headache. Vomiting daily.

June 20: Temperature normal. Pulse-rate 80. General improvement.

June 22: Headache and restlessness. Papillœdema much the same as on June 14, but some hæmorrhages noted on the left side.

June 25: Severe headache.

July 1: Administration of sulphonamide discontinued.

July 5: General condition satisfactory. Patient commenced to get up.

July 12: Report by Specialist in Ophthalmology: "Vision,  $\frac{5}{6}$ ,  $\frac{5}{6}$ . Acute papillœdema in each eye; right  $2\frac{1}{2}$  dioptries, left 3 dioptries. Gross swelling, much exudate and many hæmorrhages. The exudate and hæmorrhages are fresh, and there is no suggestion whatever of a defervescing condition; it is in full blast now. There are very marked radiating retinal tension lines around the macula on each side typical of such a papillœdema. There is not much loss of visual acuity, but this sort of papillœdema cannot be ignored too long on account of the risk of optic atrophy. There is evidence of loss of power in each external rectus, but I find it hard to elicit any diplopia. Paresis, not paralysis, of these muscles is present."

July 13: Lumbar puncture. Pressure 400 millimetres. Protein and cell content normal. After 30 cubic centimetres had been removed the manometer indicated normal pressure.

July 17: Lumbar puncture. Pressure 360 millimetres. Normal pressure recorded after removal of 20 cubic centimetres.

July 21: Lumbar puncture. Pressure 180 millimetres and showed a normal rise on compression of the left jugular vein. Papillœdema about two dioptries in each eye; hæmorrhages and exudate less than previously.

July 29: Lumbar puncture. Pressure 330 millimetres. Normal pressure after removal of 10 cubic centimetres. Definite improvement in the eye condition. Unaided vision almost  $\frac{5}{6}$  in each eye. Papillœdema about one dioptre. Hæmorrhages present mostly residual. Margins of the disc seen.

August 14: Complained that vision in the left eye was occasionally



blurred. Vision  $\frac{5}{6}$ ,  $\frac{5}{6}$ . No headache. One flame-shaped hæmorrhage in the right fundus, otherwise none. Papillœdema about one dioptré in each eye. Peripheral fields normal. Blinds spots, great enlargement.

September 1. Ophthalmoscopic appearances improved. There were no hæmorrhages and the margins of the discs could be seen more clearly.

February, 1938: Patient readmitted to hospital on account of recurrence of otitis media. Vision was normal; there had been no headache since September. Margins of discs slightly blurred. Pressure of cerebrospinal fluid, 180 millimetres.

The case was first seen in consultation on June 3, 1937, when a diagnosis of otitic hydrocephalus was considered but excluded on account of the general clinical condition and the absence of papillœdema. The severe headache and frequent vomiting at this stage were probably due to a preliminary meningitis which preceded the development of hydrocephalus. This sequence of events is not uncommon, and attention is drawn to it by Symonds, in whose original communication it is well illustrated in two of the cases described. The rigors, hæmoptysis, hæmaturia, and retrosternal abscess were probably embolic in origin and caused by an inflammatory condition of the wall of the lateral sinus. They were arrested by tying the jugular vein, and, in the case of the retrosternal abscess, by drainage. Papillœdema was first observed during the period of recovery following these operations and increased steadily to assume alarming proportions until arrested by lumbar puncture. This course is not unusual. It is well illustrated in Case 2 of a series published by Symonds [2]. In this case the appearances of the fundus a month after operation on a partially thrombosed lateral sinus were practically identical with those seen at the same period in the case under review. When the condition was fully developed the pyrexia had subsided and the headaches were becoming less frequent. This feature of such cases, as previously mentioned, was described by Symonds and Cairns [4] in commenting on a case which he described under the name of "arachnoiditis (serous meningitis)," he also mentions that headache may be so slight that the underlying condition may not be suspected until sight is seriously impaired. Cairns also noted the tendency in such cases towards spontaneous recovery, but he described a case in a boy, aged 5, in whom the papillœdema progressed to optic atrophy and resulted in complete blindness. In commenting on this case this writer stressed the importance of ophthalmoscopy in all cases of aural disease which show any signs of intracranial disturbance.

I have to thank Colonel (now Major General) R. W. D. Leslie, O.B.E., for his kind permission to send the case notes for publication. I have also to acknowledge my indebtedness to Major J. Biggam, M.C., R.A.M.C., Specialist in Ophthalmology, the Queen Alexandra Military Hospital, and to Major J. Hare O.B.E., R.A.M.C., Specialist in Diseases of the Ear, Nose and Throat, the Queen Alexandra Military Hospital, for their kind assistance in placing their records of the case at my disposal for publication.

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## SPRING TRANSPORT FOR A DIFFICULT CASE.

BY LIEUTENANT-COLONEL T. O. THOMPSON,  
*Royal Army Medical Corps.*

THE following brief account with its illustrations of a method used for transporting a serious case may be of use to others for similar occasions.

The case in point was that of L. ———, who was shot through the neck in Waziristan in June, 1937. The bullet entered the right shoulder and came out on the left side of the base of the neck. In its course it affected the posterior parts of the 5th and 6th cervical vertebræ.

The patient was in hospital in Razmak in a plaster jacket for some two months and made considerable progress. In the third week in October he was, however, in a state of considerable hyperæsthesia of the limbs, with rigidity of arm and leg joints, there were sores over pressure points in spite of great care and attention to nursing and his mental condition was deteriorating.

Opinions varied somewhat as to the immediate need for laminectomy ; but one urgent need was quite evident, namely that he should be got away from Razmak as soon as possible. It should be explained that Razmak is somewhat isolated in central Waziristan with a road sixty-nine miles to Bannu in one direction and one hundred and twelve miles to Dera Ismail Khan in the other.

This road, although possessing a very fine surface, is a hill road which crosses many ravines and watercourses and several passes.

There is an air-landing ground at Razmak, but it is restricted and too dangerous for large transport planes. The patient also was not in a fit condition to be placed on a stretcher, and therefore air transport was out of the question.

An attempt had been made to transfer him out of Razmak by slinging his bed in a three-ton lorry by means of suspension springs and straps. The three-ton lorry is a big awkward thing to drive, and requires constant gear-changing on the Razmak-Bannu road and gear-changing produces harsh vibrations throughout the vehicle.

A journey of three miles in three-quarters of an hour was accomplished, but the patient could not stand much more and in addition difficulties as to road picketing and timings had to be considered. The road to Bannu was picketed the whole way and times were limited. A speed of four

miles an hour would have made the journey much too prolonged to complete in one day.

Having seen pictures and a description of the appliances used in the three-ton lorry one was immediately struck with the idea that a lighter, well sprung, more powerful vehicle was obviously indicated for the work. Ford V-8, two-stretcher, ambulance cars had recently been issued to various districts and it appeared to the writer that if a spring bed could be slung in one of these, the problem of transport would be solved.

Accordingly a Ford V-8, two-stretcher, ambulance car was borrowed and a spring mattress bed, B.T. pattern, was procured to try out the possibilities.

The writer made a trial trip over very bad roads with a spring mattress bed merely placed in the ambulance car. The results were satisfactory.

The ambulance car with the bed was taken to the R.I.A.S.C. (M.T.) Heavy Repair shops and the idea explained; namely to have the bed adapted for slinging in the ambulance car by cutting off the legs and head piece and by providing springs on clips from which to hang the bed from the hood of the car. Without technical knowledge it was not possible to decide whether the hood was strong enough to carry the weight of the bed and patient.

If the hood of the car was not strong enough to take the weight of the slung bed, then, it was explained, that a framework in which the bed could be slung and which could be lifted into the car would meet the case. In fact the second method would be much better for the special patient under consideration.

The technical Motor Transport officers immediately vetoed slinging the bed to the hood because of its lack of strength and agreed to make a framework in which the bed could be slung and lifted as a whole into the car.

The ingenious device illustrated below was produced by them ready for the road in two and a half days, the work being carried on all night.

The Ford V-8 ambulance body only takes two stretchers and so only had just enough room for the bed in a frame. Therefore all stretcher and seat fittings had to be removed. Runner channels were fixed on the seats to allow the frame to slide in easily and to hold it in position and stout wooden guides were also fixed to take the weight of the steel frame.

These runners were placed so that the frame was to one side of the body, thus allowing an attendant just room to attend to the patient, if required (*see fig. 3*).

The legs and upper part of the head of the spring mattress were removed. The foot piece and half the head were retained in order to give firm support to any mattress and bedding used by the patient and also to give easy hand-hold for lifting the bed.

Swingle-tree hooks (screw hooks) were bolted to the bed, five at each side and three at each end. On to these hooks pairs of springs were

fastened on wire loops. Quick release hooks, four at each side and two at each end, were also bolted to the bed to take the counter-tension springs (see figs. 1 and 3).

The springs were canopy springs, i.e. the springs which are normally used to hold down the sides of the bonnets of lorries.

The steel frame was made as shown in fig. 1, all transverse supports being at the bottom. Swingle-tree hooks were bolted to the lower edge to take the counter-tension springs, quick release hooks being fixed to the upper edge.

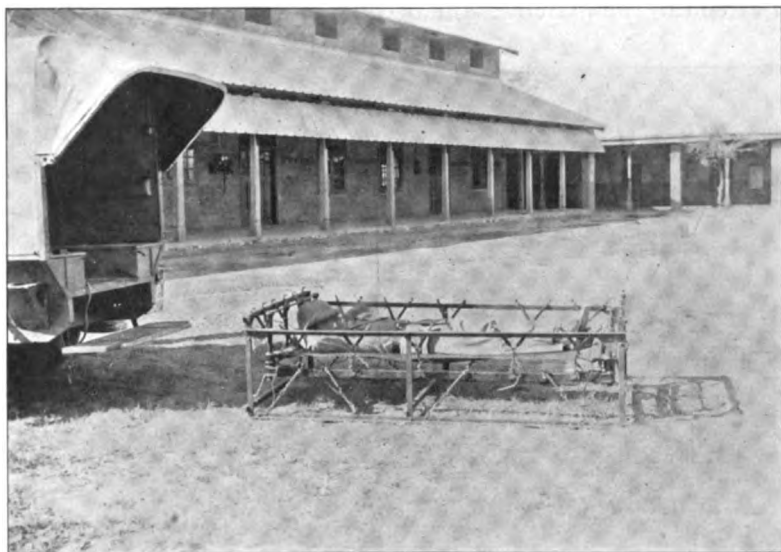


FIG. 1.—Steel frame with bed completely slung ready for loading. Note the pairs of suspension springs above and the counter springs below. In whatever direction pressure is exerted on the bed, spring action is immediately brought into play and reduces the extent and severity of the movement. Note also the ball-bearing trolley wheels at the head end of the steel frame; one is visible at the left-hand bottom corner of the steel frame.

The process of loading a patient is as follows :—When the patient is ready on the bed, this is lifted by the head and foot pieces above the steel frame and lowered into it until the frame of the bed rests securely on the wooden blocks.

The pairs of springs are then fixed on to the screw hooks on the bed by the wire loops and the upper ends clipped on to the quick release hooks on the steel frame, care being taken not to jar the patient. The head and foot of the bed are finished first and the side hooks afterwards. The bed is now suspended from the top of the steel frame.

The counter tension hooks are similarly applied and the whole is now ready for loading (see fig. 1).

The whole steel frame is raised, with the bed suspended in it, and the

head end placed in the ambulance car with the two trolley wheels engaging in the runners fixed to the seats of the car. The whole steel frame can then be easily pushed in its final position in the car (*see* fig. 2).

When the whole steel frame has been pushed into position a pair of straps secure the bottom of it to the floor of the car as shown in fig. 3. The step is then raised and fixed in position for travelling. A wooden batten has been fixed on to the edge of the step and this engages with the bottom of the steel frame and securely holds it from any backward movement (*see* fig. 3). The front partition of the body was partly removed and a flap cover substituted so that the attendant, seated beside the driver, can easily see and attend to the patient if the necessity should arise.



FIG. 2.—Sliding the loaded frame into the car. Note the springs, hooks and clips are very clearly shown.

A trial run over the training mountain track showed the result to be very satisfactory at speeds up to fifteen miles per hour and complete comfort was observed at 35 miles per hour on ordinary straight roads.

It should be noted that a set of large size low pressure tyres, which will be the future standard tyre for ambulance cars, was available and these were fitted to this ambulance car for this journey.

Two points were noted during the trial and steps were taken at Razmak to deal with these for this occasion.

The first point was the lateral roll of the patient on the bed when the car cornered. This was overcome by bolsters on each side of the patient.

The second was the ultra-spring movement of the mattress of the bed which gave too much body movement to the patient. This was most in-

geniously overcome by interposing a large sheet of Cellotex fibre board (used for ceilings) between the spring mattress of the bed and the Dunlop pillow mattress on which the patient was lying. This device damped down the vertical movements of the centre of the bed.

The car reached Razmak in a day and a half and after a trial by the officers in charge of the case was, with the corrections mentioned above, found to be satisfactory for transport of the case.

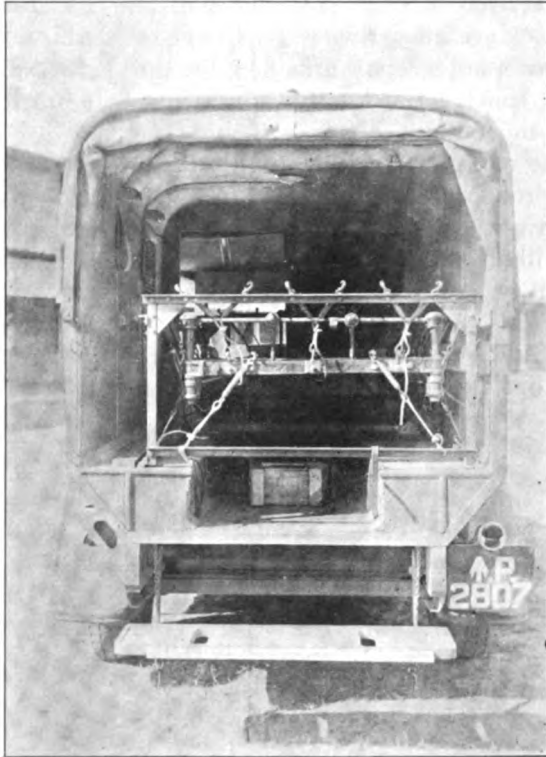


FIG. 3.—The apparatus loaded and ready for the journey. Note, there is just room for an attendant to pass alongside the steel frame and get at the patient. Note also the runner channel and guides on the seat of the car on left side. The wooden batten on the step engages with and holds the steel frame when the step is raised into the closed position.

The actual journey was performed in three stages. Razmak to Bannu sixty-nine miles. The patient arrived in excellent condition and spent a good night without any drugs, still on the bed in the frame, which was carried into the ward.

Bannu to Kohat and on to Peshawar. Seventy-nine plus forty miles. This journey was done without the aid of any drugs. The patient stated that at times it was painful (probably on account of his sores). The Kohat pass was climbed at fifteen to twenty miles per hour without changing gear.

A day's rest was allowed at Peshawar, the patient remaining on the bed, which was supported on boxes in the ward.

Peshawar to Rawalpindi one hundred and five miles. Paraldehyde was given for this journey which was done in three hours; thirty-five miles per hour being the speed used, wherever cattle fairs and similar obstructions allowed of such a pace. The Staff-Serjeant driver, a most experienced man specially selected for this journey, was full of praise for the amazing lack of vibration in the car.

The patient arrived in excellent condition and has been showing remarkable progress since his arrival. It is hoped that this account, together with the excellent photographs provided by the R.I.A.S.C. officers concerned with the construction of the apparatus, will prove of use should others require to move a difficult case of this type.

I would like to record our special thanks to the officers and staff of the R.I.A.S.C. who produced this apparatus in such a short space of time and assisted in the transport of this case and in particular to Lieutenant-Colonel R. J. Wilkinson, O.B.E., and Major J. D. F. Fisher under whose expert guidance it was devised.

My thanks are also due to Major-General W. H. Hamilton, C.B., C.I.E., C.B.E., D.S.O., K.H.S., I.M.S., D.D.M.S., Northern Command, for permission to carry out the idea and to offer this account for publication.

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## Echoes of the Past.

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### THE MEDICAL SERVICES IN GERMANY DURING THE SEVEN YEARS WAR, 1758-1762.

BY LIEUTENANT-COLONEL G. A. KEMPTHORNE, D.S.O.,  
*Royal Army Medical Corps (Retired Pay).*

IN 1756 a league was formed by France, Austria, Russia, Saxony, and Sweden to crush the rising power of Frederick the Great of Prussia. The invasion of Saxony by Frederick followed, which was the commencement of the Seven Years War.

Our immediate interest, the protection of Hanover being involved, a large subsidy was voted for the support of the Hanoverian Army which took the field under the Duke of Cumberland in 1757. In June this Army suffered defeat at Hastenbeck, and Hanover and Brunswick were overrun by the French.

In September 1758 it was decided to send British troops to Germany to be placed under the command of Prince Frederick of Brunswick, a most capable general who had already forced the French back over the Rhine. Their immediate Commander, the Duke of Marlborough, died soon after



the landing, and the Second-in-Command, Lord George Sackville, succeeded him.

Though Germany may have been the main theatre of operations, this war, which laid the foundations of the British Empire, was world wide, resulting in the conquest of Canada, the overthrow of the French influence in India, and the acquisition of various West Indian possessions.

Being inferior in numerical strength, Prince Frederick did not as a rule seek to engage in general actions, but in April, 1759, he advanced to attempt the expulsion of the French from Frankfort and Hesse. Compelled to



retreat, his army of 45,000 was opposed by an enemy 60,000 strong who had occupied Minden, but which by a series of skilful manœuvres was brought to battle under somewhat more favourable terms on August 1.

By misunderstanding of an order the British 12th, 20th, 23rd, 25th, 37th, and 51st Foot, followed by some Hanoverian battalions, advanced straight on the masses of French cavalry who were protected by the cross fire of artillery. They pierced the lines, drove off four cavalry charges and a brigade of infantry, forcing back the whole French Army in disorder with the loss of 10,000 prisoners, 17 colours, and 45 guns, their own losses amounting to something like 30 per cent. The completeness of the victory was only marred by the failure of Sackville, either from lack of nerve or from antipathy for the Commander-in-Chief, to throw in the British cavalry



in spite of his repeated orders to do so. This deplorable person, as Sir John Fortescue calls him, was duly cashiered, but turns up later in history as Secretary of State for the Colonies when his ineptitude contributed largely to Burgoyne's disaster at Saratoga.

The command of the British and Hanoverian contingent now devolved on the Marquis of Granby, a popular hero whose portrait is to be found on the signs of many of our public houses. Under his leadership the cavalry at Warburg (July 31, 1760) successfully wiped out the reproach of Minden and further enhanced their reputation in later engagements. The battle honour "Emsdorff" borne by the 15th Hussars and a German dragoon regiment commemorates the charge in which they captured a complete French infantry battalion. Apart from Minden, only one other distinction is borne on the colours of the infantry for this campaign. The 5th (Northumberland) Fusiliers were granted the battle honour "Willemstahl" for their conduct in that battle on June 24, 1762.

The war in Germany was one of reverses as well as victories, and when in 1762, to our no great credit, we made a separate peace, things seem to have been, so far as the Continent was concerned, much as they were at the start.

In 1780 appeared the second edition of Dr. Donald Monro's *Observations on the Means of Preserving the Health of Soldiers* which supplies some information on the medical organization of this campaign. The author was the son of John Monro who had served as a surgeon in the Army of William III, and later, when Professor of Anatomy at Edinburgh, lent his help to the wounded after the battle of Preston Pans. His grandfather, Sir Alexander Monro, fought on the King's side at the Battle of Worcester. He took his Edinburgh M.D. in 1753 at the age of 26, and the L.R.C.P., London, in 1758, when he was on the staff of St. George's Hospital. He was gazetted an Army physician in December, 1760, and served in Germany for the next three years. In the summers of 1778 and 1779 he was physician in charge of a large camp formed at Coxheath, near Maidstone. He was F.R.S. 1766, and F.R.C.P. 1771. He died in 1802.

During the campaign both regimental and general hospitals were employed, but during the four or five months when the Army was in winter quarters houses were hired by the regimental surgeons and the general hospitals were normally closed down, some of the senior members being detailed to garrisons as consultants. The physicians who had charge of the general hospitals regarded the Physician General of the Army as their chief, in this case Dr. William Mushet<sup>1</sup>. The Directors of Hospitals, of whom Monro mentions two, Mr. Robert Cathcart and Mr. Philip Burlton,<sup>2</sup> were really purveyors charged with the placing of contracts,

<sup>1</sup> William Mushet, M.D.Camb., F.R.C.P.Lond. Present at Minden and received the thanks of Parliament. [D.N.B.]

<sup>2</sup> Philip Burlton, staff surgeon, Germany, 1758. Inspector Regimental Hospitals. 1760. Inspector General and Chief Director of Hospitals, 1761 [Johnston].

selection of hospital buildings, etc., but he hints that being at headquarters they acquired undue influence in the posting and control of the medical staff. He strongly deprecated the habit which had recently grown up of appointing "some physical person" to be both director and purveyor, as the temptation to acquire wealth at the expense of the sick soldier was almost irresistible.

Upon entering the field, the patients in the regimental infirmaries were transferred to a general hospital, but the surgeons usually had with them a proportion of tents which could be pitched in rear of the camp to receive casualties until transport could be found either to carry them back or to bring up the Flying Hospital. On the eve of the battle of Minden orders were given for the Flying Hospital at Drakensberg to be moved up to Petershagen, about 5 miles in rear. For this move the river Weser was available. Unlike the unit so named in William the Third's Irish campaign, the Flying Hospital does not seem to have had its own means of transport. Staff surgeons took the field with each brigade, and one or two physicians and an apothecary were attached to the headquarters.

The writer has found no records of complaints regarding the treatment of the patients in the general hospitals such as are found during the war of the French Revolution, but then, and for long after, the sufferings of the wounded during transport over broken roads was one of the greatest horrors of war.

Unless he was specially allocated for surgical cases, the head of a hospital was a physician. Next to the physician and surgeon ranked the apothecary among whose duties were the care of the medicines, the inspection of the wards and dinners, and the supervision of the dispensing done by the hospital mates. The mates attended at 8 a.m. at the apothecary's shop to make up their own medicines and then accompanied the physician or surgeon round the wards to take down prescriptions or take their orders. They bled the patients as required and performed the necessary dressings. Two were on duty all day in the apothecary's shop to receive patients and for these Lord Granby authorized a joint of meat daily and a bottle of wine. Their pay in 1758 had been raised from 2s. 6d. to 3s. 6d. The purveyor performed quartermaster's duties and was responsible for preparing the sick returns.

Monro says that "as men in time of service are often apt to saunter in and about hospitals and learn all manner of debaucheries and lose all sense of discipline, a military inspector and convalescent duty officers should be appointed in every large hospital." The inspector in his own hospital was Captain Douglas, "esteemed a good officer and much afflicted by the gout." Among his duties was the arrangement of billets for convalescents, and the officers under him were frequently employed in command of men returning to their regiments, a most unpopular duty. The author urges the desirability for purposes of discipline of giving the medical staff military rank.

The duties of the matron or head nurse call for no particular comment. Among the duties of the "common nurses," usually soldiers' wives, was the obligation to keep themselves and their wards extremely clean and not to throw nastiness out of the window. Every morning they sprinkled the ward with vinegar and fumigated it with the smoke of wetted gunpowder. When the "physical gentleman" visited cases of malignant fever the nurse held a bowl of camphorated vinegar under his nose for his protection. Nurses guilty of great neglect of duty, drunkenness, or stealing the effects of the dead, were put in the guard room, court-martialled, and confined, whipped, or otherwise punished. Patients on admission were washed all over or put in a warm bath and afterwards had to wash their face and hands daily and their feet occasionally. They received clean linen twice a week.

The full diet of a patient in hospital was: for breakfast, water gruel made with oatmeal or rice with or without a little sweet oil or two spoonfuls of wine; for dinner, a pound of boiled meat; and supper, as for breakfast. One pound of bread was issued daily to each patient. For drink small beer, barley water with two or three spoonfuls of brandy, or sweetened wine and water. It is presumed that such vegetables as were obtainable were mixed with the stew. The cost of a soldier in hospital was reckoned to be 1s. 2d. a day, towards which 5d. was recoverable from his pay.

To avoid overcrowding, convalescents were usually put out into billets, but at Osnabrouk, in April, 1761, a convalescent hospital was formed, where the full diet of three meals was served in a dining hall. The men were strictly confined to the building, but those able to do so were marched into the country for half an hour or more daily. We meet these hospitals later in the Peninsular War where the maintenance of discipline proved beyond the power of the convalescent duty officers, and the patients were constantly found drunk in the streets of Lisbon.

We learn something in Monro's book also of the soldier out of hospital. The men were still clothed by their colonels, who were entitled to make what profit they could out of the transaction. The cavalry had the advantage of possessing long cloaks, but, except for a proportion of watch coats issued in some regiments, the infantry were unprovided for. He considered a flannel waistcoat, a comforter, and a second pair of boots and socks most necessary. The issue of two blankets per tent was a comparatively recent innovation. Straw was laid on the ground, and, when under canvas in the winter, the tents might be thatched or the earth excavated and covered in with hurdles.

There was an allowance of one pound of bread a day and the regiment contracted with a butcher who took his animals into the field and felled them at a fixed price. The men were grouped in messes, each of which was compelled to take their portion, which was paid for out of stoppages from pay. The best conducted regiments retained their butcher while in

winter quarters and saw that the men took their meat. The more provident colonels also laid in a stock of vegetables for the men to buy in the winter months. There was, however, always a temptation to spend the meagre remnant of their pay on spirits, which were cheap and easily obtainable. Cases of scurvy sometimes occurred.

Among minor ailments, scabies was a common cause of temporary inefficiency. Of the *lues venerea* he saw comparatively few cases, though he had ample experience of its effects at Coxheath Camp, near Maidstone, in 1778-79.<sup>1</sup> There were the usual number of cases of intermitting and autumnal remitting fever, some of them "degenerating" into continuous fever, no doubt frequently enteric. His description of 800 cases of the latter, with 38 deaths, at Coxheath is that of a typical typhoid epidemic. Cases of jaundice were common towards the end of every campaigning season, and in the winter of 1760 he describes it as epidemic. "Where it appeared in dropsical cases depending on obstructive viscera it was generally fatal." There were sporadic cases of smallpox and of the cholera morbus, the last evidently very mild.

In the autumn of 1760, when the Army had been camped for four months about the battlefield of Warburg, and both soldiers and inhabitants were reduced to great want and discomfort, there was an outbreak of putrid malignant fever (typhus) and dysentery, which laid waste whole villages. In the winter the regimental hospitals at and around Paderborne were overcrowded, and in many cases extremely dirty and ill-found. On arriving there in January, Monro immediately started to billet out the convalescent patients, with good results; others were moved to Hervorden. In April, 1761, the advance of the French caused the evacuation of all the hospitals to Osnabrouk and afterwards to Bremen, but a hospital at Alsfeld fell into the enemy's hands. Later there were establishments at Bielfeld and Natzungen. At all these places he claims to have cut short epidemics by insisting on cleanliness, ventilation, and the spacing of beds. The next winter there were cases of scurvy among the private soldiers at Bremen and in the spring many civilians died of influenza. He says that the only military fatalities were among soldiers who remained in their lodgings and indulged in drink instead of bleeding and living low, and who reported sick only after "peripneumony" had developed.

The physicians mentioned by Monro as his brother officers in Germany are Sir Clifton Wintringham<sup>2</sup> (1743), the late Dr. Richard Conyers<sup>3</sup> (1758), Dr. William Mushet<sup>4</sup> (1760), Dr. Thomas Brooke (1760), Dr. Robert

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<sup>1</sup> On the report of the French landing in 1779 there were 251 men unfit to march in a strength of about 8,000. Those in hospital included venereal 49, smallpox 35. The 115 cases attending had "mostly ulcers or slight venereal complaints."

<sup>2</sup> Physician General 1786-94.

<sup>3</sup> M.D.Oxford 1749, F.R.C.P. 1750.

<sup>4</sup> M.D.Camb. 1746, F.R.C.P. 1749. He was Physician-in-chief at Minden.

Knox<sup>1</sup> (1760), the late Dr. John Armstrong (1760), Dr. Robert Miller, formerly of the 8th Foot (1761), and Dr. Richard Turner (1762) who was commissioned as an apothecary in 1756.

The following staff surgeons are extracted from Johnston's Roll: William Young (1756), described as master surgeon, N. America, 1757; John Wallace (1758); Philip Burlton (1758); John Howell, master surgeon (1759); John Barker, from 33rd F. (1760); Edward Vaughan (1760); Henry Sandys (1760); John Ruding, from H.G.G. (1760); James Inglis, from 5th F. (1761); William Pearson, surgeon 23rd F. at Minden (1761); Gilbert Elliott, from 15th Dg. (1761); Abraham Gordon, from Buffs (1761); Francis Edwards, from 1st Dg. (1761); Richard Turner, from 50th F. (1761); Abraham Godfrey, from 3rd Dg. (1761).

In England at this time regular troops and militia were camped at various centres for the protection of the south coast, and the raids made on the coast of France necessitated the concentration of a considerable force in the Isle of Wight.

In October, 1758, following the failure of the attack on St. Malo, all the barns, vacant cottages and available buildings in and round Newport, including Carisbrooke Castle, were taken up for the reception of sick soldiers. The physician employed was Richard Brocklesby, M.D., F.R.C.P., a disciple of Sir John Pringle, who published his *Oeconomical and Medical Observations tending to the Improvement of Military Hospitals and the Cure of Camp Diseases* in 1764. He found great overcrowding and high mortality, which he succeeded to some extent in reducing. To demonstrate the value of ventilation and adequate spacing of beds he established a hospital in rough temporary sheds in Parkhurst Forest, where the patients thrived. Later he persuaded the commandants at Winchester and Guildford to build similar structures to house the regimental infirmaries, and with equal success. Accounts of both Monro and Brocklesby are to be found in the *Dictionary of National Biography*.



<sup>1</sup> M.D.St. Andrews, F.R.C.P. 1786, physician, Middlesex Hospital.

## Current Literature.

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BUSACCA, A. Recenti studii sulla "*rickettsia del tracoma*" e su altre questioni relative alla etiologia e alla patologia sperimentale di questa malattia. [*Rickettsia as the Causative Organism of Trachoma*]. *Boll. Istituto Sieroterap. Milanese*. 1937, v. 16, 689-94. [32 refs.]

In Busacca's opinion, with which the reviewer is inclined to agree, the true solution of the mystery of trachoma seems at last to have been found. Busacca himself seems to have been the first to call attention to the presence of small corpuscles in trachomatous tissue, which he believed to be rickettsiæ. These are small round or oval bodies, often in pairs, joined by an intercalary piece. His observation was followed by that of Thygeson, and later by that of Cuénod and Nataf, whose papers have been reviewed in this *Bulletin*. Poleff was able to cultivate the rickettsiæ in trachomatous tissue, but the growth stopped with the death of the tissue cells. As has been reported in this *Bulletin* [1936, v. 11, 917; 1937, v. 12, 644], Cuénod and Nataf have succeeded in growing the organisms in the intestines of living lice, and from these have derived a material which reproduced the disease in monkeys and in a blind human eye in which they have later demonstrated the presence of rickettsiæ.

Busacca has noticed, during the microscopical examination of fragments of trachomatous corneæ, certain cells undergoing "ballonierende degeneratio" of Unna; the changes in these cells resemble the changes found in herpes, and Busacca was led to place trachoma near the group of these diseases. He tried to discover whether inoculation of trachomatous material in various organs would produce specific lesions. He limited his experiments after the first to inoculation of the vitreous; after much work he concludes that the nodules which follow the injection of trachomatous and other material in the eye are neither solely due to nor pathognomonic of trachoma. Poleff recently has reported the formation of endocular nodules, after inoculation with trachomatous matter, in which he has observed rickettsia, and has also seen them in cultures from these nodules.

Cuénod in 1921 showed that the virus of trachoma can be conserved in the tissue of the testicle; Busacca later, making similar experiments, found that in the guinea-pig such inoculations brought on a chronic inflammatory process, which could be passed from one animal to another; rickettsiæ could be found in the tissues.

It is interesting to compare these views with the opinion expressed by V. Meloni in the May-June number of *Rassegna Italiana d'Ottalmologia* (p. 326 *et seq.*). For Meloni, it is proved that no parasite is the cause of trachoma, but that it is primarily an alteration in the development of the

adenoid tissue which underlies the mucous membrane of the nasopharynx and extends to the subconjunctival tissue. On this soil may be implanted various pathogenic organisms, and it is these which constitute the contagious part of trachoma. Probably all are agreed that the secondary infections, superposed on trachoma, are the chief factors in producing damage to sight, but it is difficult to believe that trachoma is not contagious, apart from the secondary bacteria. Fortunately in England trachoma is now so rare that few ophthalmologists here have the opportunity of studying the disease in a large number of cases, and the question is therefore one which must be decided by others.

HAROLD GRIMSDALE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 3.*

FREDERICK, R. C.; PRICE, C. W.; FRAENKEL, E. M. **Discussion on Air-Conditioning. Ventilation Conditions and their Investigation** [FREDERICK]. *Proc. Roy. Soc. Med.* 1937, v. 30, 1541-3 (Sect. of Epidem. & State Med., with Sect. of Med. 67-9). **Air-Conditioning in Factories** [PRICE]. *Ibid.* 1544-7 (Sect. of Epidem. & State Med., with Sect. of Med., 70-3). **Air-Purification and Allergic Conditions** [FRAENKEL]. *Ibid.* 1547-9 (Sect. of Epidem. & State Med., with Sect. of Med., 73-5). [14 refs.]

Below are summarized three papers presented at the Royal Society of Medicine, Section of Epidemiology and State Medicine with Section of Medicine, May 28, 1937.

FREDERICK, R. C.—*Ventilation Conditions and their Investigation.*

The author holds that the first requirement of ship ventilation in the Royal Navy is to keep down massive infections that may spread as a result of the necessarily crowded conditions. Carbon dioxide concentration, though of no importance in itself, serves as a useful indication of the rate of air change. The author holds that 9 parts CO<sub>2</sub> per 10,000 parts of air indicates satisfactory air change.

The Pitot tube and "Alnor Velometer" are cited as instruments to measure the flow of air through and out of ducts.

Temperatures and humidities are discussed and some of the recognized standards for measuring comfortable conditions are mentioned.

PRICE, C. W.—*Air Conditioning in Factories.*

Factories, as provided for by the Factory Acts, include a vast variety of industrial buildings, ranging from flour mills to potteries, so that it is impossible to consider any single system of ventilation as applicable to factories in general.

Full air-conditioning has been provided in many factories, but always

as a means to facilitate the treatment of products, and sometimes to the disadvantage of the operatives. On the other hand, a large number of works are fitted with partial air-conditioning—warming and perhaps filtering the air, for the benefit of the workers. Atmospheric conditions in this country, however, do not call for complete air-conditioning of factory air.

The Factories Bill, now under discussion, contains both modified and new provisions for the regulation of atmospheric conditions in the generality of workrooms. If these provisions become law, they will assist in bringing about somewhat more efficient ventilation in many workrooms. For one thing, specific regulation of temperature would apply over a wide field by the proposed imposition for certain sedentary work of a minimum temperature, 60°F., after the first hour. Again, all dusts will have to be extracted—not only those known to be harmful—and the minimum air space per worker would be raised to 400 cubic feet.

In not a few factories conditions have already been greatly improved by the enterprise of the management anticipating statutory requirements.

FRAENKEL, E. M.—*Air-Purification and Allergic Conditions.*

The treatment of air supplied for the curing or amelioration of allergic patients essentially calls for filtering rather than for air conditioning as generally understood. The author states that many of the allergic substances to which individuals may be sensitive are produced indoors—dusts from materials such as those of which bedding is composed. It has recently been found that kapok—used in mattresses—though harmless when fresh, can develop allergic properties. It is therefore important that rooms used for treating allergic cases should be carefully designed to prevent the formation or accumulation of dusts. The author contends that non-febrile “colds,” bronchitis and rhinitis may be due to allergy rather than to infections.

Air purification by refrigeration, as used by Storm van Leeuwen, is described and many references are made to other work in connection with the filtering of air to free it from allergens. It is noted that rooms designed for this purpose may be converted into gas shelters.

T. C. ANGUS.

*Reprinted from “Bulletin of Hygiene,” Vol. 13, No. 5.*

JOSELIN, E. L. **Air Conditioning.** *J. Inst. Heating & Ventilating Engineers.* 1937, v. 5, 297-314, 10 figs.

This paper deals with the fundamentals of air conditioning as distinct from ventilation. The two reasons for the use of air conditioning are stated to be “human comfort” and “material betterment.”

Although the application of air conditioning *per se* need not involve any fresh or outside air supply to the enclosures it is generally conceded



that a certain rate of outside air supply is necessary. For economic reasons it is desirable to keep this fresh air supply as small as possible. American experimenters have recently decided that the intensity of body odour in inhabited buildings is a safe criterion on which to base fresh air supply quantities. It has been found that outside air supply may be reduced to 25 per cent. if a larger quantity of enclosed air is recirculated and properly washed. The spray water and air ducts must be kept clean.

Dealing with air conditioning used for chemical and industrial processes the importance of absorbed water or "regain" in many materials (a function of relative humidity) is stressed and tables of desirable relative humidities for working various materials are reproduced at the end of the article. The calculations involved in air conditioning problems are dealt with at length and many examples are worked out in full.

The well-known Carrier Psychometric Chart for the determination of total heat, absolute humidity and other properties of air containing water vapour is reproduced. The author also gives a somewhat similar chart adapted by himself for use under conditions more generally met with in this country, total heats being calculated above 32° F. instead of above 0° F. as in the Carrier chart. The Oldham, Mollier and Bulkeley charts are also illustrated and described. The action of spray chambers in washing air and controlling humidity is described and illustrated with diagrams and photographs.

T. C. ANGUS.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 5.*

KEEFER, C. S., INGELFINGER, F. J., & SPINK, W. W. **Significance of Hemolytic Streptococcic Bacteremia. A Study of Two Hundred and Forty-Six Patients.** *Arch. Intern. Med.* 1937, v. 60, 1084-97, 7 charts.

The following observations were made on the basis of a clinical study of 246 patients with hæmolytic streptococcal bacteræmia. Bacteræmia was seen most often in patients in the first, fourth and seventh decades. These peaks of incidence correspond with the age-incidence of infections of the throat and middle ear, puerperal infections and cellulitis and erysipelas respectively. The general fatality-rate was 72 per cent. It was highest for patients with cellulitis and erysipelas regardless of age, and lowest for patients under 20 years of age with infections of throat, middle ear and mastoid. The commonest metastatic lesions were in the joints, subcutaneous tissues and endocardium. Only about 30 per cent. of the patients showed metastasis. Cases are recorded where recovery followed a transient bacteriæmia without metastases. The organisms obtained from the local lesions and from the circulating blood in all the patients were *beta*-hæmolytic. They all belonged to Lancefield's group A and they all produced fibrinolysin. Organisms isolated from the blood frequently

were resistant to phagocytosis and were not killed by the blood of normal persons. In patients with bacteriæmia antibodies develop which apparently aid in clearing the blood stream. All the patients in the present series who recovered had demonstrable antibodies in their blood and antibodies were present in some of the patients who died, though in low titre.

C. C. OKELL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 5.*

THORNTON, L. H. D., & DARMADY, E. M. **Prevalence of Sonne Enteritis.** *Lancet*, 1938, Jan. 1, 25-6.

In November, 1937, an explosive outbreak of thirty cases of Sonne dysentery occurred within five days among the male inmates of a colony for mental defectives in Wiltshire. Attacks more closely resembled food poisoning than true dysentery in the acuteness of onset, the presence of vomiting, and the transient nature of the illness. Patients and convalescents were rigidly segregated and examination of the stools of the apparently healthy disclosed two carriers, one of whom was regularly employed in washing dishes. Isolation of these brought the epidemic to an end. Plates taken in the first twenty-four hours of illness showed almost pure growth of the Sonne bacillus but after three days it became much more difficult to isolate. Also, plates must be inoculated within two hours if reliable results are to be obtained and specimens of actual fæces are preferable to rectal swabs. Bacteriological investigation was also made into cases of sporadic diarrhoea throughout the whole county, and of thirty such examinations six cases of Sonne infection were detected. All examinations for Flexner dysentery were negative. In the bacteriological examination the authors found that some strains of the Sonne bacillus tended to extremely early production of acid in lactose and recommend therefore that suspected colonies should be picked off the plates at twenty-four hours. They also emphasize the importance of employing high titre "pure" specific antisera for large-scale investigation of dysentery outbreaks.

A. JOE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 5.*

PYGOTT, F. **A Ward Epidemic of Sonne Dysentery.** *Lancet*. 1938, Jan. 29, 255-6. [12 refs.]

The ward in which this epidemic occurred contained twenty-seven patients aged from 18 months to twelve years and fifteen cases occurred over a period of five weeks. Closing the ward to new patients and the prompt isolation of each case as it occurred had no effect in subduing the outbreak. The signs and symptoms of the disease were as commonly

encountered, but one unusual feature was the tendency to relapse which occurred in five of the fifteen cases. *Bact. dysenteriae* Sonne was found in the stools of nine cases, and the author emphasizes that stool culture will not establish the diagnosis in every case in an outbreak. Little help was obtained from agglutination reactions. Reliance must be placed on the clinical picture and cases treated as if all were bacteriologically proven. The author also draws attention to the high infectivity of the disease which he regards as being as great as that of chickenpox or measles.

A. JOE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 5.*

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## Reviews.

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ROSS INSTITUTE—INDUSTRIAL ADVISORY COMMITTEE. Report of a Meeting of the Industrial Advisory Committee of the Ross Institute on Friday, April 29, 1938.

The main object of this Industrial Advisory Committee of the Ross Institute is to provide opportunities for discussion among members in regard to health difficulties occurring in their varied interests and by this means to give some publicity to those with similar difficulties and to enable greater and more advantageous use of the Institute in overcoming these.

The report under review shows clearly the valuable work being done by the Committee.

Mr. G. H. Masefield, in his opening address, referred among other matters to important steps that had been taken with a view to the Ross Institute assisting in antimalaria work in plantations and the like in Ceylon and India through the medium of malaria control committees either formed or to be formed.

He mentioned also measures taken to obtain reduction in freight rates on approved antimalaria mixtures in India, South Africa, Rhodesia and elsewhere, the importance of which from the point of view of malaria prevention needs no emphasis. He specified particularly in connexion with the Belgian Congo the financial advantages obtained and quoted the fact that antimalaria mixtures can in this area now be carried by rail at Fr. 45 against a previous figure of Fr. 1560.

Mr. Masefield also called attention to the holding of a Malaria Control Course for Laymen to be held from June 27 to July 1, manifestly an invaluable aid to such control.

Sir Malcolm Watson stressed the progress being made in Yugoslavia, Malaya and Ceylon in regard to the prevention of disease and said that it was impossible to fail to realize that a new era has opened for tropical

regions. He made special reference to the housing of labour and improvements in this direction made in Malaya with their favourable repercussion on the health of the labourer, and consequently on his efficiency.

He also drew attention to the increased use of stream flushing in malaria prevention and the evolution of a simple type of automatic flushing apparatus, and pointed out that the method is highly destructive even of those species of mosquitoes which have a high capacity for living in running water.

Developments in the use of shade were also brought to notice and the meeting reminded of the value of this and of the fact that the selection of the most useful plants for shading small streams was now possible.

In conclusion he mentioned the importance of antimalaria oil mixtures, and informed the meeting of the researches recently carried out at the Ross Institute which have given fuller knowledge of how oil acts on mosquito larvæ, and have consequently given a new and very reliable test for the efficiency of such oils.

Professor W. W. Jameson had interesting details to give in connection with hygiene in the Gezira which lies south of Khartoum between the Blue and White Niles. This previously arid waste with an undernourished population has now a settled population of 250,000 and an immigrant population of 100,000—the latter chiefly pilgrims on their way to and from the Hedjaz.

The speaker showed how consequent upon the following by the Sudan Government of advice given by the medical and sanitary staff, particularly in regard to the control of irrigation and other antimalaria measures, the incidence of malaria has been kept down to comparatively low limits.

In regard to bilharzia also, he drew attention to the excellent results achieved, which were endorsed by an infection rate of only 0·09 per cent in the Gezira, where all the conditions necessary for a serious degree of infection with this disease are present. The precautionary measures adopted comprised mainly the annual inspection of the indigenous population, the compulsory treatment of infected cases, the moving of villages where possible to at least 300 metres from the nearest canal, the fencing of canals and the piping of water for drinking purposes; the provision of well water supplies and latrines and the destruction of the infecting snails during the non-watering periods by the partial emptying of the canals and the use of disinfectants.

Dr. G. P. Crowden reported that an air conditioned cubicle for use in the tropics had now reached its final form and that it comprised twenty-one separate panels each weighing twenty-seven pounds and the whole capable of being easily fitted together, within an hour. With an outside temperature of 100° F. dry bulb and 90° F. wet bulb the temperatures in the cubicle were 81° F. and 69° F. respectively, with an admission of 25 cubic feet of fresh air per minute, this amount of fresh air being adequate for two occupants.

The meeting concluded with a discussion.

HANDBOOK OF PRACTICAL BACTERIOLOGY: A GUIDE TO BACTERIOLOGICAL LABORATORY WORK. Fifth Edition. By T. J. Mackie, M.D., D.P.H., and J. E. McCartney, M.D., D.Sc. 1938. Pp. 586. Edinburgh: E. and S. Livingstone. Price 12s. 6d. net.

This excellent manual fittingly celebrates its appearance as a fifth edition by adopting the title of "Handbook" in place of its old name, "An Introduction to Practical Bacteriology." It certainly needs no introduction to army bacteriologists, to whom it has for many years been one of the recommended text books.

The subject matter is presented in three parts. Part I is introductory, and gives an account of the classification, general morphology, and biology of bacteria, together with a brief but lucid exposition of immunity in relation to bacteriology.

Part II is devoted to bacteriological technique, and in the limited compass of 238 pages deals with this subject in a most comprehensive way. In range it covers everything likely to be required by the average laboratory not engaged in highly specialized work, yet its simplicity is such that it is suitable for the instruction of the most junior student. In addition to the usual sections on the microscope, sterilization, culture-medium preparation, cultivation of bacteria, section cutting and staining, full details are given of the technique adopted in the Wassermann reaction, the bacteriological examination of water and milk, blood culture, and the testing of surgical catgut for sterility, to mention but a meagre selection. In keeping with the growing importance of filterable viruses, there is, at the end of the book, an appendix on methods of filtration.

In Part III, in addition to adequate accounts of all these organisms—including bacteria, filterable viruses, rickettsias, spirochaetes, fungi, and protozoa—which are found in man either as pathogens or as saprophytes, brief but useful descriptions are given of the more important allied organisms which infect domestic and other animals. Little of real importance has been omitted, although the amount of space devoted to certain matters is necessarily limited. As the book is primarily intended for the use of bacteriologists practising in the United Kingdom, it is natural that subjects which are chiefly of interest to the worker in the tropics should receive more superficial attention. In these matters students will find it necessary to refer to more specialised textbooks.

The keynote of this book is its practical outlook. It is clear that the authors have spared no pains to include the truth, the whole truth, and nothing but the truth in its most practical aspects: they have been singularly successful in their efforts. The "Handbook" can be heartily recommended to all who are interested in bacteriology, and especially to those whose duty it is to teach students and laboratory assistants.

J. S. K. B.

A NEW DICTIONARY FOR NURSES. By Lois Oakes, S.R.N., D.N. 1938. Pp. xx + 397. Edinburgh: E. and S. Livingstone. Price 3s. net.

This little book should prove a valuable addition to every nurse's library. The definitions are clear and concise and are accompanied by useful illustrations. Much useful information is contained in the Appendix, particularly with reference to "Gas Warfare Precautions." The book is of convenient size, and the printing and arrangement are excellent.

THE MEDICAL ANNUAL, 1938 (Fifty-Sixth Year). Editors: H. Letheby Tidy, M.A., M.D.Oxon., F.R.C.P.; and A. Rendle Short, M.D., B.S., B.Sc., F.R.C.S. 1938. Pp. lxxii + 694. Bristol: John Wright and Sons, Ltd. London: Simpkin Marshall Ltd. Price 20s. net.

The Medical Annual for 1938 has maintained its usual high standard, again providing an excellent review of the advances in medicine during the preceding year. There is a useful summary of the subject of blood groups, the technique of grouping is described with the factors affecting the re-action and possible sources of error, including pseudo and cold agglutination. The new agglutinogens M. and N. in human blood-cells are dealt with and their application to disputed blood relationship is discussed. It is shown how blood-group tests may offer conclusive evidence that a certain man could not be the father of a particular child, but can never prove that he is the father. The new M. and N. tests have doubled the chances of proving non-paternity.

Under arrhythmias and electrocardiography the value of IV lead is discussed, showing that it has a definite place in cardiology. Dr. Stanley Davidson contributes a review of the literature on anæmic and iron metabolism. He also deals with Banti's syndrome and draws attention to the unfavourable prognosis in cases with hæmatemesis, despite splenectomy.

Lymphogranuloma inguinale is considered and the value of the Frei test in confirming the diagnosis. Stricture of the rectum in women frequently supervenes owing to spread of the infection by deep lymphatics around the rectum to the anorectal glands.

Professor Heathcote reviews the subject of insoluble insulin in the treatment of diabetes—protamine insulin and protamine zinc insulin. He also deals with ergotamine and its clinical application in migraine. Bazedrine has been shown to act promptly in bringing about relaxation of spasm of the gastro-intestinal tract, however caused. The sulphonamides and the chemotherapy of bacterial invasions are dealt with very fully. The relations of the various preparations are discussed, and their method of action and their therapeutic application to various clinical conditions described. The toxic manifestations which have been reported are also described.

Dr. Gardiner-Hill reviews the subject of the menopause and its disturb-

ances, and gives suggestions as to their management. The diseases common to man and animals is dealt with by Professor Cameron. Milk is the most common means of spread of infections, such as tuberculosis, Brucella infections and diseases due to hæmolytic streptococci, from domestic animal to man.

This work is again strongly recommended as a useful book of reference.

**A CONCISE PHARMACOLOGY.** By F. G. Hobart, Ph.C., M.P.S., and G. Melton, M.D., M.R.C.P. 1937. Pp. xiii + 171. London : Leonard Hill, Ltd.

This small book on Pharmacology should be useful to those who do not wish to study the larger textbooks on this subject. It is written primarily for undergraduates.

**NEURO-OPHTHALMOLOGY.** By Lindsay Rea, B.Sc., M.D., M.Ch., F.R.C.S. 1938. Pp. xxii + 568. London : William Heinemann (Medical Books), Ltd. Price 42s. net.

Mr. Lindsay Rea has produced a most readable textbook which is a connecting link between neurology and ophthalmology. It is well printed and the numerous illustrations are admirable. The very complete bibliography makes it a valuable book of reference. Of special interest to the military medical officer is the chapter dealing with the ocular manifestations of head injuries, also that on poisons which affect vision, this includes the deficiency diseases. The importance of correcting errors of refraction in traumatic neurosis, shell-shock and melancholia is stressed.

The book is written for the younger ophthalmic surgeons as well as for students of neurology and its fluent style commends it to all practitioners. It answers many of the questions which link these two branches of medical science.

F. R. B. S.

**SURFACE AND RADIOLOGICAL ANATOMY FOR STUDENTS AND GENERAL PRACTITIONERS.** By Arthur B. Appleton, M.A., M.D.Cantab., William J. Hamilton, M.D., B.Ch.Belf., D.Sc.Glas., F.R.S.E., and Ivan C. C. Tchaperoff, M.A., M.D., B.Ch.Cantab., D.M.R.E. 1938. Pp. xi + 311, figs. 338. Cambridge : W. Heffer and Sons, Ltd. Price 15s. net.

This book has just been published. It places before the student and general practitioner a most useful volume in which radiology and physical methods of examination have been added to the pictures obtained in the dissecting room.

Each "part" of the body as studied in the anatomy room is considered separately. After a description of the anatomy in which excellent use is made of parallel illustrations, showing the musculature depicted side

by side with surface photographs, the authors pass to sections on movements in joints, the line of pull of muscles and the radiology of the part.

In the thorax and abdomen effective use is made of anatomical diagrams studied along with radiograms.

The vascular, nervous and lymphatic systems are dealt with in the various parts as they arise.

Appendices give details of ossification and also of segmental innervation in the limbs.

The book is confidently recommended. It is beautifully produced by a process which the publishers rightly claim emphasises the detail of the illustrations, of which there are more than three hundred. It will be of great assistance to the student and to the practitioner. D. C. B.





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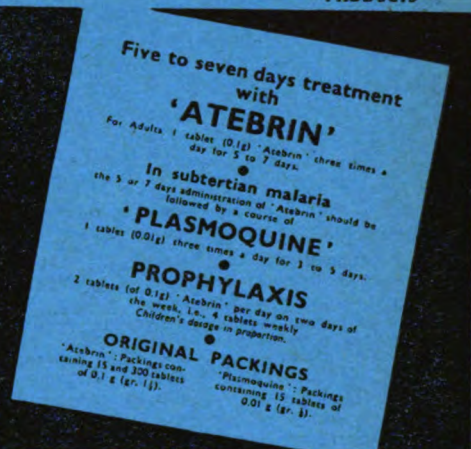
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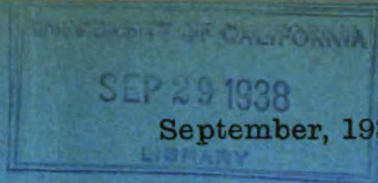
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**THE ORGANIZATION OF THE MEDICAL SERVICES IN AIR  
RAID PRECAUTIONS.**

BY COLONEL E. M. COWELL, D.S.O., T.D., D.L., F.R.C.S.

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INTRODUCTION.

THE suggestions I have to offer on medical organization are put forward after three and a half years' experience in a Casualty Clearing Station in France and nearly four years' work as a Red Cross Organizing Officer in

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the County of Surrey, working in connexion with Air Raid Precautions Schemes.

It is hoped that the details to be described will be of interest and value not only to the medical services of the forces, but also to those responsible for civilian medical organizations in connexion with Air Raid Precaution Schemes.

### AIR RAID PRECAUTIONS ABROAD.

*(A.R.P. Home Office—Passive Air Defence, P.A.D. Military.)*

Practically every "civilized" country in the world is preparing, or has already prepared, to defend its civil population against air warfare, including gas.

In Europe the preparations are advanced and in most countries complete.

*In Paris*, a large number of underground shelters have already been erected, including first-aid posts. These are protected by ceilings sufficiently strong to withstand the weight of the collapsed superstructure.

These first-aid posts are hospitals of a considerable size, with operating theatres, beds, etc., and are staffed by five to ten doctors, with nurses and Red Cross volunteers.

*In Germany*, a new pattern civilian anti-gas respirator is now being produced at the rate of 35,000 a week.

In Berlin (4,500,000) a first-aid post is organized at each police sub-station, of which there are 200. A medical officer will be in attendance and the casualties are kept on double-decked stretcher frames. Oxygen can be administered here.

These small first-aid posts are arranged in groups with an Area Command Post as headquarters.

In addition there are at present between 700 and 800 public refuges, some of large size.

Large buildings, tenements, etc., will collect wounded and evacuate direct to hospital.

The cleansing stations can put through 50 cases per hour.

### AIR ATTACK ON CIVIL POPULATION.

#### *Recent Casualty Figures.*

*In Spain*, incendiary bombs have produced little effect in the big towns, probably because so little wood is used in construction of buildings. (20-pound thermite bombs have been used.)

Gas has not yet been used.

*High Explosive Bombs.*—In 18 raids reported in Barcelona during the period November 20, 1937, to January 26, 1938, 100-pound bombs were chiefly used. The total casualties were said to be 700 killed and 700 wounded.

In one raid three or four 500-pound bombs, i.e. rather less than 1 ton, killed 220 and wounded 400.

The public appears to become quickly accustomed to raids, only showing signs of panic on the first raid.

*In China* some information is available :—

One 500 kilo bomb killed 145 and wounded 200. On another occasion in Shanghai in a short raid there were 173 killed and 549 wounded.

A press account of a Japanese raid on Chengchow in February, 1938, describes how a succession of bombers attacked the city for two hours : 80 to 100 bombs were dropped and from 500 to 1,200 people were killed or wounded. With the 100-pound bombs used 4 to 5 tons were dropped, i.e. 125 to 250 killed or wounded per ton. Three bombs fell on hospital quarters and the population became panic stricken.<sup>1</sup>

AIR RAID CASUALTIES IN LONDON. September, 1917 to May, 1918.

(Quoted from "*War Over England*," Air Commodore, L.E.O., Charlton, 1936.)

In this period there were 20 night raids by large aeroplanes. Altogether 249 left German aerodromes and 225 arrived over London.

Fifty tons, representing nearly 2,000 bombs were dropped. £1,000,000 worth of material damage was done, 435 were killed and 980 injured, a total of 1,415, i.e. 29 casualties per ton.

Daylight raids were more productive of casualties. Twenty tons thus dropped produced about the same number of casualties, i.e. 75 per ton.

In these raids 20 to 27 per cent of the casualties were produced by our own anti-aircraft gun fire.

#### EXPECTATION OF CASUALTIES IN THIS COUNTRY IN ANY FUTURE AIR ATTACK.

All European countries except perhaps Turkey can attack this island from the air.

The modern high speed bomber can fly at a height of 20,000 feet, and at a speed of 200 or more miles per hour, carrying one ton of either H.E. incendiary or gas bombs.

This performance allows hostile aircraft to attack any large town in England, Wales and Scotland, south of Edinburgh, with very little warning.

A lone bomber may be sent to a given locality to create a diversion, but the main attack would probably be carried out by formations made up of from 25 to 36 machines, operating in relays.

This type of formation (of three or four squadrons) would cover an area of about a quarter of a square mile. An interval of a mile or more may be expected between formations (see fig. 1).

Each machine will carry approximately one ton of bombs, the load being made up of four or five 500-pound bombs. This means that 25 to 36 tons of bombs can be dropped in a quarter of a square mile. The bombs may be released simultaneously or in a pattern over a considerable area.

<sup>1</sup> Recently a doctor serving with the Chinese Red Cross told the author the ratio of killed to wounded was often 3 to 1.



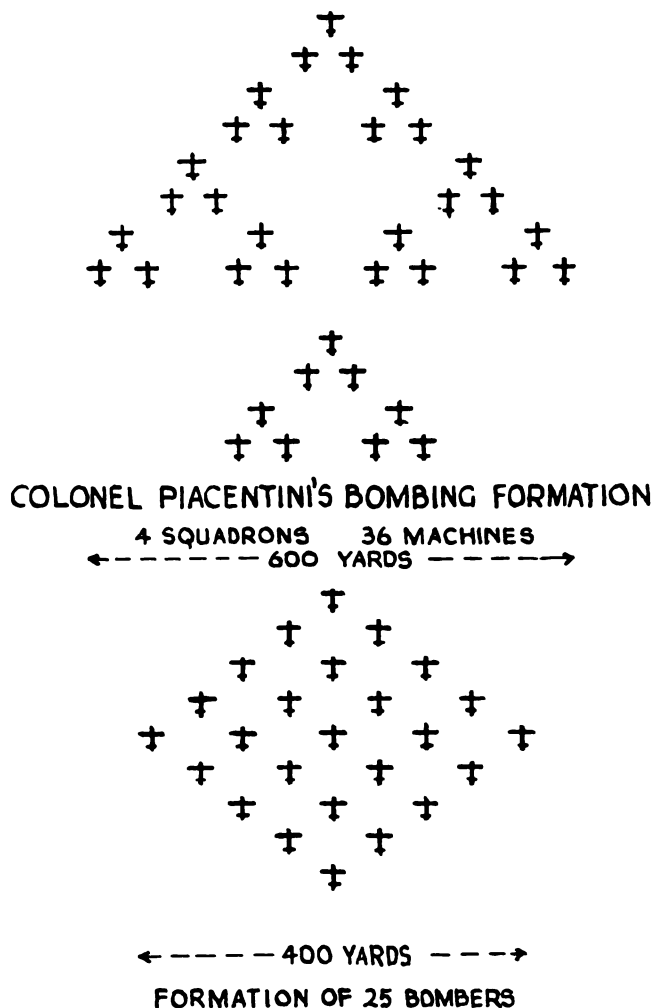


FIG. 1.

*By permission of "R.A.F. Journal."*

Working on the London figures already mentioned the expectation of casualties per ton will be :—

Time			25 Machines			36 Machines.
Night	..	..	725	..	..	1,044
Day	..	..	1,875	..	..	2,700

In London the population varies from 30,000 to 50,000 per square mile. The casualty figures will be less than the above table gives, because possibly 30 per cent of the attacking machines will themselves become casualties before reaching their objective.

Successive relays of machines may attack the same locality, at periodic intervals.

In air raids the ratio of killed to wounded will vary from 1 : 1 to 1 : 2. Of the casualties caused by H.E. the proportion of walking to lying may be taken roughly as 2 : 1. Half the walking cases may require sitting transport. The women and children will require more help than men. Unwounded parents will want to accompany their children to hospital.

Taking 2,700 as a possible number of casualties caused by one attack by a formation of thirty-six machines, the following details may be expected :—

Killed .. .. .	1,000
Lying cases .. .. .	700
Walking cases .. .. .	1,000
	<hr/>
	2,700
	<hr/>

#### ESTIMATE OF GAS CASUALTIES.

The estimate will be based on the consideration : of (1) Tonnage of bombs dropped ; (2) whether the gas is persistent or non-persistent ; (3) weather conditions ; (4) time of day ; (5) protection available ; (6) previous propaganda to allay panic ; and (7) presence of an efficient Air Raid Warden Service.

In the *R.A.F. Journal* of April, 1936, this subject is discussed in an article on "Air Strategy," written by Lieut.-General N. N. Golovine.

Estimates to "gas" the population of a big city vary from 10 to 40 grammes per square metre.

Taking an average of 25 grammes 75 tons will therefore be required per square mile.

The following table shows the requirements necessary to gas the three capital cities of London, Berlin, and Paris.

Towns	Area in sq. miles	Tons of Gas	No. of Aircraft	Engines	Crews
London .. .. .	76	5,750	5,750	11,500	23,000
Berlin .. .. .	37	2,750	2,750	5,500	11,000
Paris .. .. .	27	2,000	2,000	4,000	8,000

Of the machines required to produce the above figures 30 per cent may be estimated as failing to reach their objective. To "gas" London, therefore, 8,200 are required, and allowing for reserve engines, 33,000 would be needed, excluding fighters.

An Air Force of such magnitude is difficult to visualize ; therefore the total and simultaneous gassing of a capital city is practically impossible.

#### CASUALTIES FROM INCENDIARY BOMBS.

A single aircraft may carry 1,000 kilo electron bombs. These can be dropped in batches of 10 to 20 every second, and the operation will be over in less than one minute. At 200 miles per hour this gives a spread of 50 yards, and all the bombs may be discharged over a depth of three miles.

In a built-up area 50 per cent are effective and fires will be started.

The bomb is designed to penetrate the roof only, and sets fire to the woodwork on the attic floors.

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### GENERAL REMARKS ON AIR RAIDS ON THE CIVIL POPULATION.

The first raids will be the worst, the uncertainty of the locality to be attacked and the absence of warning make it imperative that Medical Units must be mobilized everywhere. Some of the units not actually engaged should be mobile to allow of a rapid system of reinforcement for the less fortunate neighbouring localities.

### AIR RAID PRECAUTIONS IN GREAT BRITAIN.

Preliminary plans for the protection of the civil population were initiated by the Chemical Warfare Committee about 1920, and later taken over by the Defence Against Chemical Warfare Committee.

In 1934 a brief public reference to this subject was made in the House of Commons by the Prime Minister.

In July, 1935, a circular letter was sent to all local authorities asking for the voluntary preparation of schemes and recruiting of personnel.

In 1936 many Committees were formed and A.R.P. Officers appointed.

In 1937 the movement grew slowly, and in January, 1938, the Air Raid Precautions Act became Law.

The local authority is asked to prepare a scheme, submit it to a County Officer for co-ordination with neighbouring schemes and to the Home Office for approval.

Under the Scheme an A.R.P. Headquarters with an appropriate staff will be formed and the following Services organized :—

- (1) Police.
- (2) Fire.
- (3) Engineering, including rescue and demolition, water, gas, and electricity repairs, sewage disposal, and repair and decontamination of roads.
- (4) Air Raid Wardens.
- (5) Medical.
- (6) Transport.
- (7) Communications and intelligence (Detection of gas) and warning.<sup>1</sup>

### MEDICAL ORGANIZATION.

The medical services are organized on Service lines, including first-aid parties, first-aid and cleansing posts, ambulance services, casualty clearing hospitals, special surgical centres, base hospitals, gas hospitals, records departments and headquarters, etc.

Cemeteries and central mortuaries for casualties who die from wounds and those killed outright come under the Registrar-General's department.

### HEADQUARTERS AND STAFF OFFICERS.

Under the local authorities scheme the medical officer of health is the Officer in charge of medical arrangements. His deputy will share the duties and relieve him as required.

---

<sup>1</sup>In view of the recent Home Office publication of a "Partial Evacuation Policy," an Evacuation Service (S) will probably be added to the list.

Medical headquarters will be in touch with L.A. headquarters and be notified of all events.

Reports should be received hourly or oftener from all medical units of the local authority and *all evacuation arranged centrally*.

At local headquarters relays of telephone clerks will be required and a sufficient number of runners available (cars, cycles, senior boy scouts), in case the telephone services are interrupted. Short wave two-way wireless telephony sets will be useful.<sup>1</sup>

A records office is essential. Nominal rolls of all casualties will be required for: (1) The Ministry of Pensions; (2) Home Office; (3) L.A. Records; (4) Press and notification of relatives.

In some towns it will be necessary to decentralize and establish District or Zone Headquarters.

#### CONSULTANTS.

Surgical and medical consultants should be appointed in time to assist in the training of volunteer surgeons and physicians, anæsthetists and general duty practitioners.

The present position of technique in war surgery should be made known and administrative problems discussed.

The Home Office has already given courses of lectures on defence against chemical warfare to large numbers of doctors and nurses.

#### REINFORCEMENTS AND MEDICAL STAFF ORGANIZATION.

It is obvious that the scale of medical personnel suggested may not be sufficient to cope with all eventualities in any given locality. Arrangements must be made to bring in additional personnel, and also to transfer casualties and their friends to neighbouring medical units.

This entails the establishment of a Central Medical Staff. The County Medical Officer of Health may act as Chief Medical Controller, with Deputy or Assistant Controller in the various areas into which the county may be divided.

#### MEDICAL RECORDS.

*Suggestions.*—(1) An universal issue of identity cards or discs should be made to the entire population. (2) Casualty medical cards prepared on lines of the Field Medical Card (A.F.W. 3118) should be prepared for issue to first-aid posts, casualty clearing hospitals and private doctors.

This card should be used even in minor casualties. It is suggested that the card should have a notice advising the patient who does not go at once to a medical unit, to see a doctor as soon as convenient. (3) Admission and Discharge books will be kept at first-aid posts, casualty clearing hospitals and base hospitals. (4) At *District Headquarters*. Returns to be sent hourly to Main Headquarters. Numbers in first-aid posts, numbers evacuated, etc.

---

<sup>1</sup> I have interviewed Lieutenant-Colonel E. H. Richardson on the use of dogs. The training is too laborious and expensive, although the animals have been known to operate through gassed areas.

**MEDICAL PERSONNEL REQUIRED.**

The A.R.P. Organization is the greatest task ever imposed on this country; it has been, and is up to the present time, practically a voluntary one.

In densely populated areas for all A.R.P. Services, a personnel of 1 : 30 of the population must be trained. For medical services only, 1 : 50. This allows of three eight-hour shifts. Of this medical personnel approximately 1 : 25 will be doctors for two twelve-hour shifts.

As regards a knowledge of air raids, the use of respirators, etc., the entire population, or 1 : 1 must be trained.

The following tables give details of the medical personnel required per 100,000 of the population in large towns.

Dental surgeons will be useful in A.R.P. organization. Some may act as assistants to operating surgeons, others with a little extra training as anaesthetists.

Medical students.—Those students who are undergoing their final studies will be useful in the same way as dentists.

**TABLE I.—MEDICAL PERSONNEL PER 100,000.***Table of Details of Personnel by Units (One Shift).*

Name of unit	No. of units required	Sex	Trained	Untrained	Total per unit
<b>F.A. Parties—</b>					
4 Men .. .. .	20	M.	2	2	4
<b>Motor Ambulances .. .. .</b>	20	M.	1	1	2
1 Driver					
1 Orderly					
<b>F.A. Posts .. .. .</b>	4				
1 M.O. .. .. .		M.*	17	8 )	50
4 Nurses .. .. .		W.	18	7 )	
50 O. Ranks					
<b>C.C. Hospitals .. .. .</b>	1				
10 M.O.s					
20 Nurses .. .. .		M.†	17	25 )	80
80 O. Ranks .. .. .		W.	19	19 )	
<b>Base Hospitals .. .. .</b>	2				
10 M.O.s .. .. .		M.‡	30	20 )	140
40 Nurses .. .. .		W.	50	40 )	
140 O. Ranks					
<b>Headquarters .. .. .</b>	1				
2 M.O.s .. .. .		M.	3	3 )	12
1 Matron .. .. .		W.	3	3 )	
<b>Reserves .. .. .</b>		M.	10	10 )	35
		W.	10	5 )	

\* 12 men should also be trained in nursing duties.

† 13 men should also be trained in nursing duties.

‡ 26 men should also be trained in nursing duties.

TABLE II.—MEDICAL PERSONNEL PER 100,000.

Unit	Number required	Composition	Total	Total	Total
			First shift	Two shifts	Three shifts
F.A. Party .. ..	20	4 Men	80	160	240
Motor Ambulances ..	20	1 Driver 1 Orderly	40	80	120
F.A. Post .. ..	4	1 M.O. 4 Nurses 50 O. Ranks	200	400	600
100 lying 200 sitting					
C.C. Hospital .. ..	1	10 M.O.s 20 Nurses 80 O. Ranks	80	160	240
200 beds					
Base Hospitals .. ..	2	10 M.O.s 40 Nurses 140 O. Ranks	280	560	700*
1,000 beds					
Headquarters .. ..	1	2 M.O.s 1 Matron	12	24	36
					1,936
Reserves .. ..			35		35
					1,971
M.O.s .. ..			40	80	100
Nurses .. ..			117	234	290

\* Night shift half strength only.

TABLE III.—TOTAL MEDICAL PERSONNEL PER 100,000.

*Trained, Untrained, Men and Women.*

	ONE SHIFT		TWO SHIFTS		THREE SHIFTS	
	Trained	Untrained	Trained	Untrained	Trained	Untrained
Men .. ..	193	169 = 362	386	338 = 724	549	487 = 1,036
Women .. ..	179	139 = 318	358	278 = 636	487	377 = 864
Headquarters ..	6	6 = 12	12	12 = 24	18	18 = 36
	378	314 = 692	756	628 = 1,384	1,054	882 = 1,936
Reserves .. ..	20	15 = 35	20	15 = 35	20	15 = 35
	398	329 = 727	776	643 = 1,419	1,074	897 = 1,971

Trained men i.e. passed in first aid, anti-gas .. .. 236 } = 549  
 Trained men i.e. passed in home nursing also .. .. 313 }  
 Trained women i.e. passed in first-aid, anti-gas and home nursing .. 487

In the early days of war the services of Territorial troops may be called on by the local authority. Steps should be taken now to familiarize these men in the use of protective clothing and the handling of stretchers.

In some localities there may be a shortage of able-bodied men for stretcher bearing and work in first-aid parties.

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Since many of the civilian casualties may be women and children and more easily handled than men, a certain number of women should be trained in these duties.

The onus of obtaining recruits lies on the Local Authority. The Order of St. John and the British Red Cross Society have undertaken to organize, train and maintain this large new medical personnel.

### FINDING AND FIRST-AID TREATMENT OF CASUALTIES.

In war, in the case of troops in the field, casualties are expected, and the necessary arrangements made. Each soldier has a field or shell dressing and bearers are at hand.

In A.R.P. work the attack may be sudden, with practically no warning and the target almost anywhere.

The general public must, therefore, be informed of the risks and danger of air attack. This is being done by the issue of the *Householders Handbook*, and the provision of the civilian anti-gas respirator. When the time comes it is strongly recommended that a shell dressing also be carried by all.

In order that killed, unconscious and badly wounded persons may be readily identified, it will be necessary to issue an identity disc or card. It will be the duty of air raid wardens to see that these details are in order before air raids begin.

The casualties will be found by their friends, police, firemen and air raid wardens. The last three classes of men should definitely be able to apply first-aid and make the casualties ready for collection.

Experience of several mobilization exercises in 1937 showed that casualties, although found and recognized, were not treated till the medical personnel arrived thirty to forty minutes later. Hæmorrhage cases and carbon monoxide poisoning were left alone.

The difficulties of working under air raid conditions on a very dark night, of applying splints and dressings when the operator is hampered by a respirator, gauntlets and protective clothing will be thoroughly appreciated.

### COLLECTION OF CASUALTIES.

This will probably have to be done in the dark, with perhaps the assistance of dim electric torches.

Rescue parties are being trained to get casualties out of damaged buildings. These men with police and air-raid wardens will locate the casualties, render immediate first-aid, and notify the first-aid parties for collection and evacuation.

This part of the casualty organization corresponds to that of the regimental stretcher bearers and is non-medical.

### EVACUATION.

Here the duties of the medical personnel begin. First-aid parties of four volunteer bearers (St. John or Red Cross), will either carry the stretchers by hand to the first-aid posts, or load them into motor ambulances. One trained bearer will be in charge of each party.

The provision of 20 parties is suggested for each 100,000 population, i.e. 4 parties attached to each first-aid post and 4 in reserve.

The A.R.P. memorandum, No. 1, second edition Appendix B, lays down that each member should be equipped with a G.S. respirator, protective clothing (helmet) and first-aid pouch. The party carries a stretcher in an oil-skin cover, a blanket, surgical haversack and spare respirators. The blanket may be conveniently carried in the stretcher as described in R.A.M.C. training.

The ideal pouch and haversack has not yet been found. I suggest that for convenience in working in the dark the case should be opened by a zip-fastener, and the contents should be as simple as possible. The case should contain triangular bandages, shell dressings, splints, tourniquets, scissors and safety pins, labels for priority cases, dimmed electric torches, and a notebook for messages.

The present lists are too long, roller bandages are impracticable, and other items are unnecessary.

Efficient first-aid consists in stopping bleeding, covering wounds, splinting, preventing shock, and then rapid evacuation. Time is wasted and damage done by attempting disinfection of wounds and doing too much.

Walking cases will be grouped and sent off in charge of a guide to the first-aid post.

Before evacuation begins the initial dressing may require re-adjusting and possibly tourniquets applied. Serious cases must be labelled and given priority. The leaders of first-aid parties must be told how to dispose of the casualties.

In towns where great numbers of casualties may occur, it will be advisable to send (1) all the walking and lying cases to a first-aid post; (2) certain cases to the casualty clearing hospital direct; (3) dead to the central mortuary.

#### METHOD OF CARRYING CASUALTIES.

The devices shown in figs. 2 and 3 have recently been tested and found helpful in the type of work A.R.P. emergencies will demand.

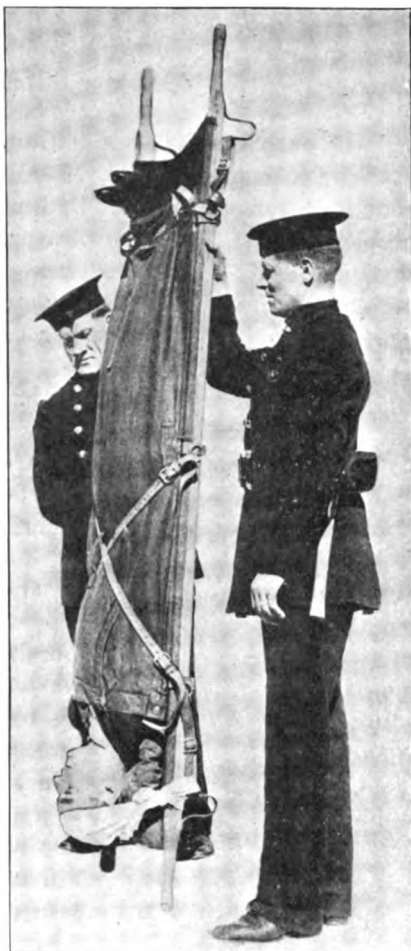
(1) *The Universal Stretcher Sheet*.—This provides extra protection for the patient, and enables the stretcher to be carried in any position. It is described in the R.A.M.C. Training 1935.

(2) *The Hip Sling*.—This provides the ideal method for two bearers to carry a heavy stretcher at the maximum speed, with the minimum fatigue.

Bearers' hands are free to hold a torch or adjust a respirator.

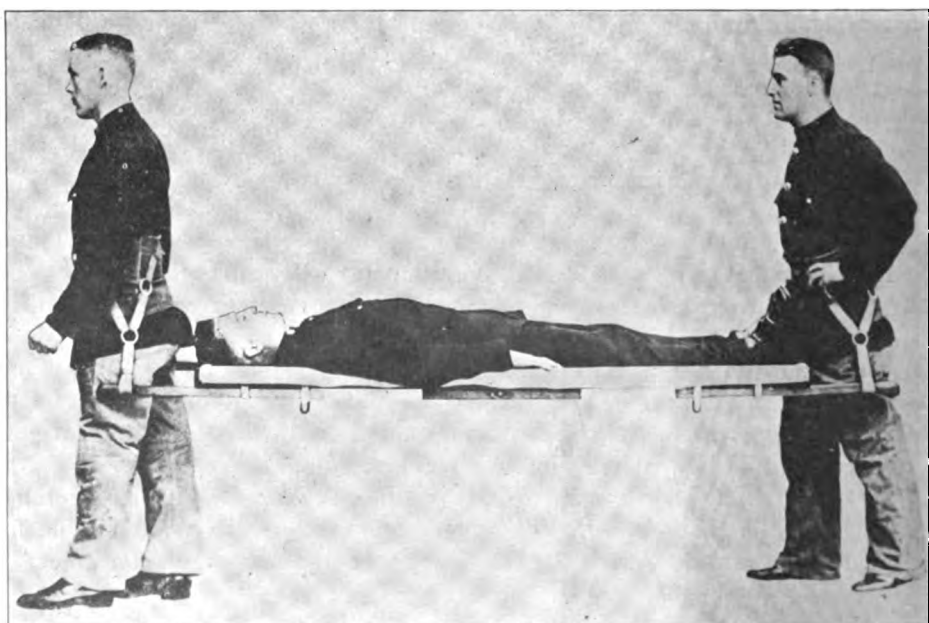
(3) *The Anti-Gas Stretcher*.—It is possible that a new pattern stretcher will shortly be introduced. The sheet or canvas will be detachable for easy decontamination, with the canvas packed in an air-tight container.





**FIG. 2 (left).—Showing security of patient regardless of position.**

**FIG. 3 (below).—Tor hip sling. Normal carry—hands free.**



## AMBULANCE TRANSPORT.

*Motor Ambulances required.*

For the transport of casualties a fleet of some 20 motor ambulances will be necessary. The existing regular ambulances will be insufficient in number and auxiliary improvised ambulances must be available. Most regular ambulances do not at present carry more than one or two stretchers, and fittings for four stretchers should now be arranged.

The Tor Stretcher Frame (see figs. 4 and 4A) provides a simple and economical method of converting a light van into a four-stretcher ambulance.

The motor ambulance should be stationed as follows :—

Station					Total vehicles.
At each F.-A. Post	..	..	2	i.e.	8
At each C.C.H.	..	..	2	„	2
Headquarter Reserve	..	..	4	„	4
					—
					14
For evacuation—At each Base Hospital	..	3	„		6
					—
					20

Arrangements must be made to replace vehicles which have become casualties, and for repair and maintenance service organized to keep vehicles on the road.

Drivers will be relieved every eight hours. Orderlies trained in first-aid are essential. They will act as spare drivers, look after the patients, help load and unload and at night guide the vehicles in the dark.

*Motor Ambulance Convoys.*

In the event of larger numbers of motor ambulances being required a pooling arrangement can be made. In addition it will be advisable to organize definite 'convoys' in cities and in each area of the County or at County Headquarters. These convoys will be in charge of a Special Officer.

*Temporary Ambulance Trains (T.A.T.'s).*

Under certain circumstances it may be useful to transport casualties by train. Certain of the base hospitals may require to be cleared to other parts of the country, and road transport may be inadequate or the distance too great.

With the use of the stretcher sheet, the short St. John's stretcher can be loaded through the door of the ordinary third-class railway carriage. A simple bracket can be fitted in a few hours, and each compartment therefore will carry four lying cases.



FIG. 4.

The Tor Stretcher  
Frame

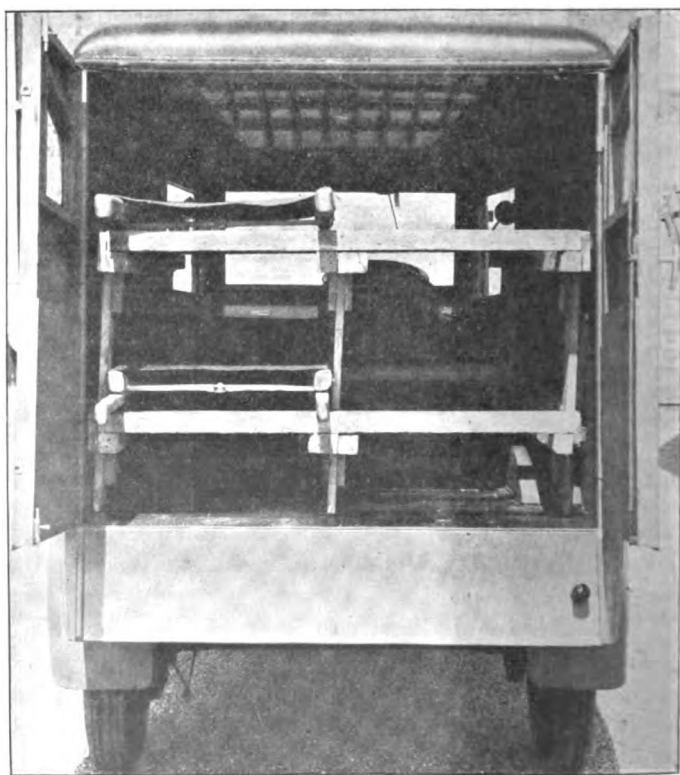


FIG. 4A.

## FIRST-AID POSTS.

A certain number of slightly wounded and gassed cases will make their way home, and call in their own doctor.

With this fact in mind, appeals have been made by the Home Office and British Medical Association for doctors to study the treatment of gas casualties.

Private practice, however, will be uneconomical of man power. Large numbers of doctors (80 per 100,000, two shifts), will be required to serve with medical units, and it is to be hoped that the profession will collaborate with Local Authorities, and volunteer their services for this organized effort.

Most of the casualties of all categories will tend to find their way to the nearest medical unit. Wardens and others concerned should be told to send, as far as possible, all cases to the nearest first-aid post, unless there is a special reason to the contrary.

## SELECTION OF BUILDINGS.

Appendix C of the A.R.P. mem., No. 1, gives full details of the first-aid posts.

Schools afford the most convenient sites, and for gas cases the necessary alterations, including provision of bathing rooms, should be taken in hand now. The cost is approximately £500 to £1,000 per first-aid post according to its size.

The lay-out must be arranged for wounded and gas cases and duplicated for the sexes (H.O. circular, December 10, 1937).

Careful organization is required to ensure a constant stream in handling the casualties. Details are clearly laid down in the appendix referred to above.

The principles of this lay-out, together with protection and location of the buildings used, are the same as those described in this paper under the heading of Casualty Clearing Hospitals.

## PROTECTION OF PATIENTS DURING AN AIR ATTACK.

It will not be possible to render the existing buildings which may be used by medical units entirely bomb-proof, splinter-proof, fire-proof and gas-proof. Attempts, however, should be made to do the best possible under the circumstances.

Where possible, sufficient six foot deep trenches may be dug in the immediate vicinity. These, if roofed and covered with a layer of sandbags, will afford some protection for those patients who can walk.

Where new hospital buildings are being erected, or new schools designed, certain details of construction may be attended to in order to render the buildings safer in the event of air attack. The ceilings of the ground floor should be strong enough to carry the weight of the structure above, and include a layer of concrete nine to twelve inches thick.

The roof, if tiled or slated, can easily be pierced by electron bombs. To prevent fires, the attic floors should be covered by a layer of fireproof

material and ready access should be planned.<sup>1</sup> A squad of auxiliary firemen should be ready to deal with this form of attack. Where additional accommodation is required, recreation grounds make good camp sites, and the tents can easily be camouflaged.

#### FIRST-AID POSTS.

These should be large enough to accommodate 300 patients, 100 lying and 200 walking. In some localities smaller ones may be prepared.

The following departments should be organized, and the lay-out consist of :—

(1) Entrance for motor ambulances, stretcher dump (blankets, etc.) (12 stretchers, 36 blankets).

(2) Office and room for C.O. (a doctor).

(3) Reception room (canteen): (a) Wounds, 40 lying, 100 walking; (b) gas, 20 walking.

(4) Treatment room. (To hold 20 at a time.) A.T.S. for all wounded.

(5) Evacuation department: Walking 100, lying 60.

(6) Detention room for moribund cases. ? Transfusion (8 beds).

(7) Special dressing-room (operating theatre) for: (i) Ligature of main vessels; (ii) closing open pneumothorax; (iii) amputation of shattered limbs.

(8) Quarters for personnel. Kitchen, ablutions, rest rooms, etc., latrines.

(9) Quartermaster's Department: Store of clothes, dispensary, office, etc.

(10) Mortuary.

*Remarks.*—It is not necessary to have separate departments for men and women. A line of screens will be sufficient to separate the sexes. These can easily be moved according to relative numbers.

The organization must be elastic: for example, arrangements should be made to increase the gas treatment department if required.

The possibility of the building becoming a casualty must not be forgotten, and an alternative site should be planned.

Reserve personnel should be in readiness, and the possibility of the first-aid post having to hold cases for some hours in a large raid until the casualty clearing hospital is cleared must not be overlooked.

In addition to the dump of 12 stretchers, and the 4 of the bearer parties, a supply of at least 50 stretchers should be available for each first-aid post that is open.

#### EVACUATION ROOM.

The evacuation room should be arranged to minimise carrying, and enable outgoing ambulances to be loaded without interfering with incoming ones.

The reception block is duplicated for gas, and the other departments are duplicated for the sexes by the moveable screen method.

<sup>1</sup> By the use of a fine hand spray, 2 gallons of water will keep the bomb from setting fire to the surrounds.

*Extra Latrine Accommodation.*

In the case of all medical units, whether in improvised buildings or in existing hospital buildings, extra latrine accommodation may be necessary.

The details of personnel employed in each department is given in the accompanying Table.

TABLE IV.—DETAILS OF FIRST-AID POST.  
*Large.*

	M.O.s	Nurses	D.O.s	Clerks	Dis- pensers	Nursing orderlies		Auxi- liaries		Cooks	Total Vol. Per- sonnel
						M.	W.	M.	W.		
1. Stretcher dump ..								1			1
2. Office .. ..	1	1	1	2				1	2		6
3. Reception (wounded) ..		1		1		1	1	4	2		9
4. Reception (gas) ..				2		6	6				14
5. Treatment .. ..						2	3				5
6. Evacuation .. ..							1	1	1		3
7. Detention .. ..		1				1	1		1		3
8. Theatre .. ..		1				1	1		1		3
9. Q.M. Department ..			1	1				1			3
Kitchen .. ..										2	2
10. Mortuary .. ..						1					1
11. Quarters for personnel											
Totals ..	1	4	2	6		12	13	8	7	2	50

*Remarks.*—This table contains a M.O. at present omitted by the H.O., otherwise it practically agrees with details laid down for a large Aid Post. Small or medium posts are staffed in proportion to their size.

The Home Office recommends the organization of three types of first-aid posts—large, medium or small. Large firms, factories, etc., will organize their own small first-aid post.

The organization of the first-aid post outlined above does not agree entirely with the official Home Office description. That authority does not recommend a medical officer, and no provision is made for life-saving operations or detention.

In my opinion, the presence of a doctor is essential. He will control the morale of the patients, diagnose doubtful cases, give priority to urgent cases, perform the immediate operations required to save life and exercise general supervision over the medical work.

He is as valuable as the Regimental Medical Officer, if not more so.

Each large first-aid post should provide accommodation for 300 patients.

## CASUALTY CLEARING HOSPITALS.

*Selection of Buildings.*

The ideal casualty clearing hospital is undoubtedly provided by the use of tents or huts. It is difficult to render these gas-proof, and existing buildings will in most cases be chosen. In A.R.P. work it will not be possible to select sites in perfectly safe localities in all cases. If tents are

used, large structures of the "Bessonneau" type are infinitely preferable to laced marquees.

#### *Protection by Signs.*

Probably in future wars forward medical units will best protect themselves by camouflage and adopting the usual precautions for concealment. Hospitals, however, should be marked, and it is suggested that the letter "H," laid out in the grounds by 3-foot strips of linen or ordinary sheets folded lengthwise, is more visible than the Geneva Cross at present employed. A Geneva Cross can be improvised by using red blankets surrounded by white sheets. The red of the cross does not show above 10,000 feet, and at greater heights the "H" is more readily seen. Above 15,000 feet it is not easy to distinguish any sign, and the amount of protection to be expected is doubtful.

These remarks apply to sites of first-aid posts, base hospitals, etc.

#### THE LAY-OUT.

Reference to plans of casualty clearing stations in action in France will show the general lay-out (see fig. 5).

Efforts should be made to save labour, maintain a constant stream and allow of reception and evacuation simultaneously.

In civil work the arrangements must be duplicated for the sexes.

Doctors who have not worked in casualty clearing stations do not grasp the idea that the casualty clearing hospital must be kept cleared, and only a small per cent of cases should be retained. Experience of one or two mobilization exercises shows a lamentable ignorance of the organization of a casualty clearing hospital.

#### ACCOMMODATION.

Arrangements should be made for the accommodation of 200 cases.

Casualty clearing hospitals should work in groups of 2, 3, or 4. A convoy of 150 casualties is admitted to the first casualty clearing hospital, after which all cases are sent on to the next casualty clearing hospital and so on. By the time the last one is full the first should be cleared and ready to take in again.

Of the 200 "beds" 75 only need actually be *beds*, the rest are stretchers.

#### NOTICE BOARDS.

All blocks, departments and wards should be clearly marked with the name of each, and signs indicating the direction of the stream of casualties.

In each department a small blackboard should be available to show the names of Sister and wardmaster on duty. This is on account of a large, oft-changing personnel, unused to the work.

*The Office* should be situated near the entrance to the casualty clearing hospital.

*The Officer in Charge* should be a doctor, with an assistant or deputy for night duty.

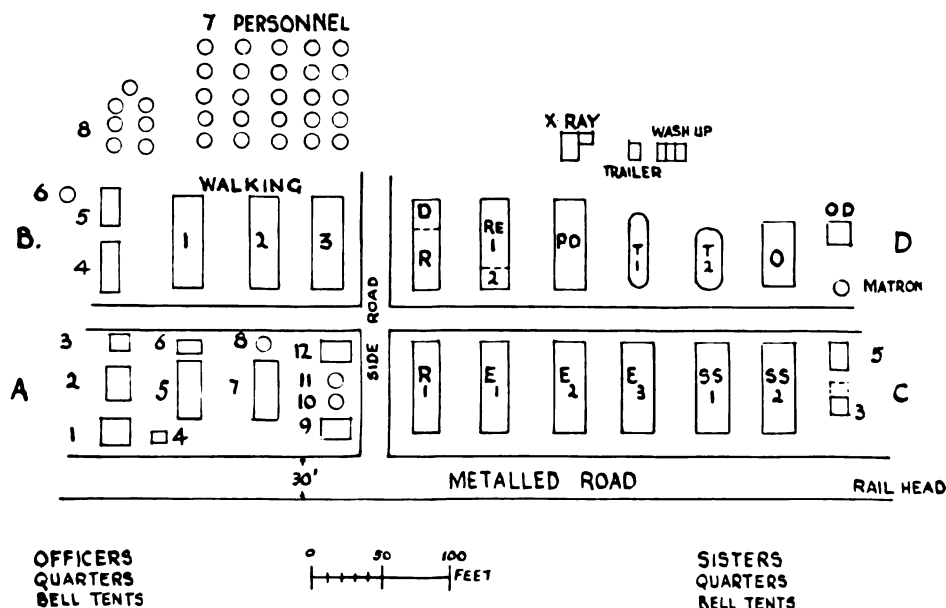


FIG. 5.—Lay-out of No. 1 C.C.S. at Escadœuvres B.E.F., Nov. 1918.

The move was completed in 27 lorry loads in forty-eight hours. The C.C.S. was planned in four blocks, advantage being taken of the main road and a good side road.

A. *Q.M. Block* comprised : (1) Cook house ; (2) Patients' dining tent ; (3) Personnel's dining tent ; (4) Water tank ; (5) Stewards' store ; (6) Serjeants' mess ; (7) Pack store ; (8) Q.M.S.'s tent ; (9) Office ; (10) C.O.'s office ; (11) R.S.M.'s tent ; (12) Dispensary.

B. *Walking Wounded Block*.—Personnel : (1), (2), (3) Wards of 5 laced marquees—stretchers ; (4) Ablution bench ; (5) Latrine ; (6) Incinerator ; (7) Personnel—bell tents ; (8) Convalescent G.D.O.'s tents.

C. *Reception and Evacuation*.—R<sub>1</sub>, E<sub>1</sub>, E<sub>2</sub>, E<sub>3</sub>—placed to allow of evacuation at the same time as reception ; S.S.<sub>1</sub>, S.S.<sub>2</sub>—serious surgical ; (3) Mortuary ; (5) Church tent.

D. *Theatre Block, Officers' Ward*.—R., Reception ; D., Dressing ; Re, Resuscitation ; P.O. Pre-operation ; T<sub>1</sub>, T<sub>2</sub>, Theatres—3 twin tables each ; X-ray ; Trailer and wash-up ; O., Officers' ward ; O.D., Officers' dining tent ; M., Matron's office.

Sisters' and Officers' Quarters.—On the opposite side of the road.

This officer keeps an eye on reception, treatment in the dressing-room and theatre, and is in constant touch with headquarters.

The rest of the C.C.H. Staff consists of (1) a surgical specialist, responsible for supervising the surgical technique ; (2) matron with an assistant for each shift ; (3) St. John or Red Cross Commandant, acting as duty officer for discipline. One is required for each shift.

#### PERFORMANCE FIGURES.

The surgical work that is done depends on the number of casualties, both actually admitted and expected.

Experience showed in France that convoys of 150 lying cases can be dealt with by 6 to 8 teams in about eight hours.

Of 150 stretcher cases probably not more than a maximum of 65 per cent require operation, that is to say 90 cases.

Six teams will therefore have 15 cases each which will take eight to ten hours.



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To save life 10 to 15 per cent of the cases must be operated upon. To save limb 16 to 25 per cent. To preserve manpower, the remainder.

In August, 1918, a casualty clearing station (No. 1 C.C.S.) was in action for ten days. Six teams were available. 1,876 lying cases were admitted and 40·8 per cent operated upon.

Here it was found that a resuscitation ward of less than 30 beds would have been adequate.

*The Lay-out.*—The entrance of the hospital should be clearly marked by day and by night, and situated so that motor ambulances can off-load and pull away without turning and congesting the road.

*Direction signs* should be erected in the neighbourhood to guide walking cases and drivers. These signs should be about two feet off the ground and capable of dull illumination at night.<sup>1</sup>

*Stretcher Dump.*—A dump of twenty-five stretchers, seventy-five blankets, splints, hot-water bottles, etc., in charge of a capable attendant should be available for rapid exchange of items brought in with the patients. This store should be gas-proof with an air-lock entry. Each casualty clearing hospital will require at least 200 stretchers, with a reserve of twenty-five.

*Reception Rooms.*—These are duplicated for wounded and gassed patients. A central line of screens will separate the sexes. A medical officer should be available for diagnosis and to supervise the sorting of cases by a nurse or experienced orderly. Sufficient accommodation should be allowed for forty stretchers and twenty sitting cases. Priority cases will be looked for and suitably dealt with.

*Clerking.*—Patients arriving from first-aid posts will have casualty medical cards already attached and made out. From these particulars will be taken for the admission and discharge book. A useful check on numbers is made by the issue of a serial number, which is pinned on to the card and collected on evacuation. Cards must be made out for patients admitted direct.

### CLERICAL PERSONNEL EMPLOYED IN A LARGE WALKING WOUNDED CASUALTY CLEARING STATION (ORGANIZED FOR WALKING WOUNDED).

At an active casualty clearing station in France, organized for walking wounded during the second battle of Cambrai in September, 1918, the following clerical staff was employed. In seven days 7,579 casualties were dealt with, rather over 1,000 a day (*see Appendix II*).

(1) Engaged in each of three large reception wards, three pairs of clerks (total 18)	18
(2) In the Records Office which send out hourly returns to Corps and Divisional Headquarters and nominal rolls to units, 1 N.C.O. in charge	1
8 clerks working in pairs, and	8
3 runners	3
(3) C.C.S. Office, compiling figures for evacuation, lists for ward orderlies, etc.	
1 chief clerk and 4 others	5
2 runners	2
Total	37

<sup>1</sup> These remarks also apply to first-aid posts.

*Patients' valuables* must be looked after in the reception room. Small bags are issued and, in the case of unconscious patients, taken to the pack store for safe keeping.

In the gas department an elaborate system of marking clothes must be employed.

#### A.T.S. TABLE.

All wounded should be given A.T.S. before leaving the reception block, adrenalin being available in case of anaphylaxis.

#### CANTEEN.

While patients are waiting they should be given hot drinks, chocolate or cigarettes.

#### STRETCHER BEARERS.

Four to six bearers in charge of an N.C.O. should always be on duty for off-loading ambulances and carrying stretchers away.

From the reception block the cases pass on as follows : (a) Walking cases and slightly wounded stretcher cases to the *treatment block* ; (b) cases requiring operation to the *pre-operation block* ; (c) all wound-shock cases to the *resuscitation ward* for blood transfusion, etc.

#### GAS CASUALTIES.

It will be impossible to refuse treatment to cases gassed in the neighbourhood of the casualty clearing station.

Arrangements must be made as in the cleansing block of a first-aid post.

Reception, undressing, cleansing, clothing, should be duplicated for the sexes.

Accommodation for 10 cases of each sex will probably be sufficient.

Phosgene cases will be admitted to a special ward. Mustard cases are sent home, or, where the eyes are affected, to a special base hospital.

#### THE TREATMENT ROOM.

This room should be large enough for 8 stretcher and 40 sitting cases.

Screens should suffice to separate the sexes. Here trivial wounds are cleaned up and dressings applied, also simple fractures are splinted.

They are then sent on to the evacuation block.

Experience in the casualty clearing station already mentioned, which was dealing with walking cases only, showed the following staff to be necessary for a large treatment department. This staff dealt with an average of 1,000 walking wounded a day for five days.

*Medical Officers*, 3.—1 Surgeon : 1 M.O. examining and signing medical cards ; 1 M.O. relief for night work.

*Sisters*, 8.—4 by day, 4 by night (1 at each table).

*N.C.O.s i/c*, 2.—1 by day, 1 by night.

*Dressers*, 32.—16 by day, 16 by night (4 at each table).

*G.D. Orderlies*, 4.—2 by day, 2 by night.

*Stretcher Bearers*, 8.—4 by day, 4 by night.

*Police*, 2.—1 by day, 1 by night to direct to evacuation ward, etc.

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The treatment room of a casualty clearing hospital will not require a large staff. The following should be detailed for duty. 1 sister or nurse; 2 men dressers, 2 women dressers (St. John or Red Cross); 1 G.D. man or woman.

A doctor should be available (the orderly M.O.).

### X-RAY DEPARTMENT.

This should be available for the examination of simple fractures sent from the treatment room and selected cases from the pre-operation ward. In rush times it is impossible to X-ray all wounded.

The staff will consist of a radiologist, sister-radiographer and attendants. Arrangements should be made to work day and night shifts.

### PRE-OPERATION WARD.

20 stretchers for each sex, separated by central screens.<sup>1</sup>

The streams of wounded and cleansed gas cases now meet. In this ward the patients are put into pyjamas, their clothes must be preserved in bundles, labelled and sent to store, or better, accompany them on the stretcher through the theatre to the wards.

They are given pre-operative medication injections of morphia, etc., and kept quiet. Priority cases are kept apart and the theatre is notified hourly of all numbers waiting operation.

### RESUSCITATION WARD.

15 beds for each sex. Experience in France shows the value of this ward. An experienced M.O. will be in charge, with a supply of transfusion apparatus, stored blood or donors, and nurses able to give intravenous injections, rectal saline, etc.

### RESUSCITATION WARD.

*Warming Apparatus.*—Electric cradles or oil stoves; if the electric supply is cut off hot-water bottles, etc., will be required. An alternative lighting system is necessary for night work. No operations should be carried out until severe wound-shock has been successfully treated.

### THE OPERATION BLOCK.

Adequate accommodation must be set aside for sterilizing dressings, preparation of instruments, washing waterproof sheets, repair of gloves, etc. A hut of the Nissen type 40 by 20 feet will suffice.

The theatre should be splinter-proof and gas-proof, and at the same time well ventilated. It should be large enough to allow of three "Teams" working at the same time. Alternative lighting systems should be arranged. For six teams two large theatres are necessary.

The speed at which large numbers of wounded can be operated depends on adequate accommodation, efficient organization with a sufficient number of stretcher bearers and orderlies.

Where the existing theatre accommodation is limited and there is only

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<sup>1</sup> Six beds should be provided for each sex for severe cases.

room for one or two Teams to work, it is suggested that two theatre huts sixty by twenty feet should be put up in the hospital grounds as near as possible to the pre-operation and resuscitation wards.

These huts can be used in peace time as depôts for all the extra stores and equipment needed.

#### SURGICAL TEAMS.

Experience in France showed the best results could be obtained with teams of eight persons made up as follows :—

- 1 surgeon and assistant.
- 1 anæsthetist.
- 1 Sister (responsible for instruments).
- 2 Orderlies (nurses).
- 2 Stretcher-bearers.

The use of the "Twin-Table-System," i.e. two tables per team, allows the second case to be prepared for operation while the first operation is being completed. Screens separate all tables, and as the patient is drowsy he is not frightened.

It should not be necessary to have separate theatres for the two sexes.

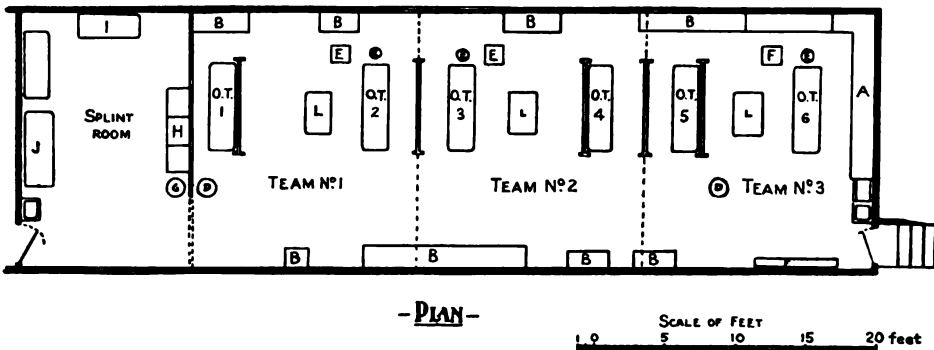


FIG. 6.—Operating Theatre No. 23 C.C.S. Plan showing arrangement of twin tables, movable screens, and trailer furniture. (A = Fixed cupboards and shelves which can be dispensed with and trailer furniture used. B = trailer furniture (containing shelves for dressings, lotions, etc., and washup for surgeons). C = Operating tables 1 to 6. D = Stoves. E = Anæsthetic table and stool. F = Form for bearers. G = Autoclave. H = Sterilizing rack. I = Splint rack. J = Mackintosh washup. L = Instrument table.)

For three teams a room with a floor space, 60 by 20 feet, is needed. Twelve feet are partitioned off for sterilizing and washing mackintoshes, etc., and keeping the patients' stretchers. The remaining 48 feet is divided equally between the three teams. Screens on castors separate the tables.

For work in a C.C. Hospital Theatre accommodation for six teams is advised. One duty officer is allotted to three teams.

A clerk is available for all surgeons to dictate notes for the medical cards, and to complete a theatre book. The number of casualties waiting operation is entered hourly on a small blackboard.

Experienced teams should be able to deal with an average of 1·8 cases per hour. In dealing with heavy casualties six teams will certainly be required.

#### OPERATING TABLES.

It is not necessary to use an expensive and elaborate operating table. A simple type, as issued to casualty clearing stations, is satisfactory. The table must not be too low and should be capable of being put into the Trendelenberg position.

#### OPERATING THEATRE VEHICLES.

Expensive mobile operating theatres have been designed and advocated from time to time. The public imagination is fired by the dash of such a unit, rushing up to a casualty in the field and operating on the spot, perhaps under fire. This practice is bad and to be heartily condemned. It is easy for the surgeon and his team to take the risk, but it is very bad for the patient. Very few serious operation cases can stand evacuation immediately after operation, and it is harmful for the patient's morale to be left in the danger zone.

The surgical maxim must remain: "Efficient first-aid in the Field and rapid evacuation to hospital."

Another type of mobile theatre, however, exists, designed to carry a large operating tent and all surgical equipment sufficient for a large number of operations. This is the Wallace-Cowell theatre, lorry and trailer, described in the *R.A.M.C. Journal*, 1917. The provision of this equipment is worth considering in A.R.P. medical organization.

#### EVACUATION BLOCK.

Arrange accommodation for 10 sitting and 40 lying (duplicated for sexes). (33 stretchers, 7 beds, i.e. total accommodation for 100 cases.)

The bulk of the cases operated can be evacuated quite soon after operation. They are made comfortable on their stretchers and given drinks. Numbers are notified to the office periodically.

1 sister, 2 orderlies or Red Cross nurses and 1 G.D. orderly should be available for each 40 patients.

#### SERIOUS SURGICAL BLOCK. (15 Beds, duplicated for Sexes.)

Some 10 per cent of operated cases will not be fit for immediate removal. These include head, chest and abdominal cases and fractured femurs.

A larger nursing staff will be required in each of these wards. (2 sisters, 2 nursing orderlies, 1 auxiliary.)

#### *Gas Wards.*

These may be required for mustard and phosgene cases. Arrangements must be made for the administration of oxygen. The illustration (Fig. 7) shows a simple open-top oxygen tent, of the "Tor" pattern—which is fire-proof.

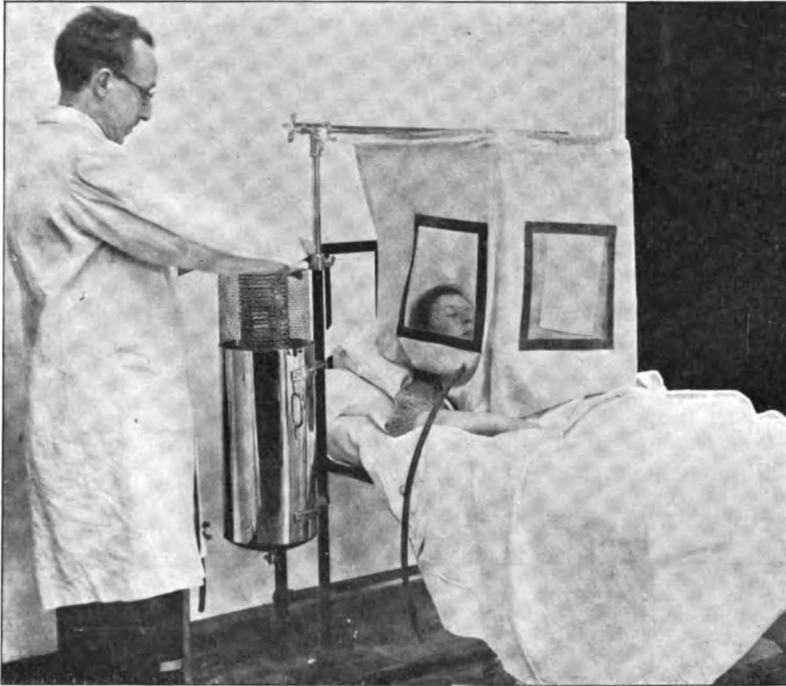


FIG. 7.—Open top oxygen Tent of the Tor pattern.

#### KITCHEN ARRANGEMENTS.

The patients must be given suitable food and drinks and the personnel will require feeding.

#### QUARTERMASTERS DEPARTMENT.

In addition to the feeding problem, a dispensary must be organized capable of providing large quantities of dressings, with stores of oxygen, bleach paste and other special items.

A lock-up store with a responsible staff is required to deal with the patients' valuables.

#### QUARTERS FOR PERSONNEL.

Most of the additional and auxiliary personnel will live in their own homes, and only require feeding during their tour of duty. Rest and changing rooms and washing arrangements will be required and, perhaps, extra lavatory accommodation.

#### MORTUARY.

This is generally forgotten in mobilization exercises.

The details of employment of the personnel of a casualty clearing hospital per shift are given in Table V.

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### MOBILITY OF A CASUALTY CLEARING STATION.

During the period of stationary warfare in France, some of the casualty clearing stations accumulated equipment and tended to become cumbersome units incapable of rapid movement. No. 1 Casualty Clearing Station, for instance, having been in the same Chateau grounds at Choques for about three and a half years, occupied eighty lorries in its first move.

Its final move at the end of the War carried all requisites for a 500-bedded casualty clearing station in 27 loads.

The casualty clearing station should be prepared to move as a heavy and light section.

In August, 1918, a light section moved 20 kilometres from Pernes to Ligny St. Flochel. The stores and equipment were in readiness for loading and a canvas site that had been a main dressing station, was ready for occupation. The lorries were loaded and left at 06.00 hours. The new Camp was reached at 08.00 hours. Two large theatres were erected and at 12.00 hours a convoy of 150 lying wounded arrived.

TABLE V.—DETAILS OF CASUALTY CLEARING HOSPITAL.

	M.O.s	Nurses	D.O.s	Clerks	Dis- pensers	Nursing Orderlies		Auxili- aries		Cooks	Total Vol. Per- sonnel
						M.	W.	M.	W.		
1. Stretcher dump ..								1			1
2. Office .. ..	1	1	1	2				2	2		7
3. Reception (wounded) ..	1	1		2		1	2	4	1		10
4. " (gas) .. ..	1	1				3	3				6
5. Treatment .. ..		1				1	1		1		3
6. Pre-op. .. ..		2				1	1	1	1		4
7. Resuscitation .. ..	1	4				2	2	1	1		6
8. Theatre (teams 3) ..	6	3	1	1			3	8	1		14
9. Evacuation S. .. ..									1		1
10. " L. (M.) .. ..		1				2		1			3
11. " L. (F.) .. ..		1					2		1		3
12. Serious surgical (M.) ..		2				1		1			2
13. " " (F.) .. ..		2					1		1		2
14. Gas wards .. ..		1				1	2		1		4
15. Q.M. .. ..			1	1	1			1	2		6
16. Kitchen .. ..								2		2	4
17. Personnel quarters ..								1	1		2
18. Mortuary .. ..						1		1			2
19. Laundry (normal staff)											
Totals .. ..	10	20	3	6	1	13	17	22	16	2	80

*Remarks.*—This table is practically the same as that laid down in War Establishments for a casualty clearing station. It will probably be necessary to reinforce the stretcher-bearers and nursing sisters. Three or more extra surgical teams may be required.

### SPECIAL SURGICAL CENTRES.

As the result of experience in France "Bowlby's" rule was evolved. This gives an expectation in a given number of casualties of 2 per cent for each class of serious wounds, i.e. abdominals, head and compound femurs, etc.

If possible such cases should be selected at the first-aid posts or casualty clearing hospitals and sent direct to the S.S.C.

Here the most expert surgeons, anæsthetists and an adequate nursing staff will be ready.

Evacuation will not be so rapid as in a casualty clearing hospital.

Accommodation on a scale of 30 beds per 100,000 should be arranged.

#### BASE HOSPITALS.

It has already been stated that a town of 100,000 may expect a maximum of 2,700 casualties from a simple daylight attack by one squadron. This attack might be repeated at least once in the twenty-four hours, producing a total casualty list of 5,400 cases made up as follows:—

Killed	..	..	..	..	2,000
Seriously wounded	..	..	..	..	1,400
Slightly wounded	..	..	..	..	2,000
					<hr/> 5,400

Of the seriously wounded 10 per cent will be retained in the casualty clearing hospitals, and of the slightly wounded perhaps 10 per cent would be unable to go to their homes. The death rate of the seriously wounded will be 10 to 15 per cent in the first few days.

Accommodation must therefore be available for 1,500 to 2,000 casualties in the first double raid. The raids may be repeated perhaps in the next ten days. Hospital accommodation may therefore be required for 3,000 beds in a population of 100,000. This is an enormous figure, but raids will be localized, and base hospitals of neighbouring localities should be organized to meet the situation.

Mental hospitals, which exist in many instances on the outskirts of large towns, are admirably suited for base hospitals.

Failing the presence of suitable buildings, hospital marquees or tents of the Bessonneau type must be used.

#### *Situation.*

The site should be as far removed as possible from any definite target, on a good road, accessible to a railway line for ambulance trains, and be provided with a water and electric light supply and if possible on a drainage system.

#### *Organization and Lay-out.*

The general arrangement is much simpler than that of a casualty clearing hospital and approximates more closely to those of an ordinary civil hospital.

#### *Personnel.*

The war establishment of a general hospital of 600 beds is given as:—  
Medical Officers 22, Quartermasters 1, N.C.O.s 15, Other Ranks 127, Sisters, 50.



### *Observations.*

It is extremely unlikely that more than a few base hospitals will be in action at a time.

It will be possible therefore to make up the large staff of nurses required by moving them from the hospitals which are closed to those open.

As regards doctors, their work in first-aid posts and casualty clearing hospitals will only be of short duration. Raids will not last continuously day after day. This will enable them to attend at the base hospitals.

Base hospital personnel also may be spared for duty at the first-aid posts and casualty clearing hospitals during rush periods.

The nursing orderlies and auxiliaries should be found locally.

### SPECIAL HOSPITALS.

It will probably be found necessary to organize special base hospitals, where there are suitable staffs of surgeons and nurses. These will include orthopædic, nerve, plastic and eye centres, etc.

### EVACUATION FROM BASE HOSPITALS.

Three motor ambulances will be stationed at each base hospital. These will be pooled for evacuation purposes and also use made of the other vehicles available.

The employment of temporary ambulance trains has already been mentioned.

### OTHER METHODS OF TRANSPORT.

*Water.*—In some localities evacuation by barges on river or canal may be practicable.

*Air.*—Air ambulances will be available. A D.H. Dragon will carry four lying cases cruising at 140 miles per hour.

This method will only be useful for certain selected cases and will depend on the proximity of aerodromes for taking off and landing.

### PATHOLOGICAL LABORATORIES.

Some extra laboratory accommodation will be required. One for each group of three casualty clearing hospitals, and one for each group of two base hospitals should suffice.

This will mean the formation of panels of doctors possessing the requisite special knowledge and willing to act as pathologists.

### DEPOTS OF MEDICAL STORES.

A central depot should be organized early. One depot will suffice for several small Local Authorities where the population is under 50,000.

The Officer-in-Charge should be an experienced Quartermaster, ex-R.A.M.C. if possible. He should be appointed as soon as stores begin to accumulate, at a part-time salary.

## SUMMARY AND CONCLUSIONS.

(1) The organization required under the A.R.P. schemes is colossal. For all purposes including medical, a personnel of 1 : 30 of the population is required at the lowest estimate.

The medical personnel figure alone works out at approximately 1 : 50.

(2) A large newly organized personnel is being recruited by the local authority and trained by the Order of St. John and the British Red Cross Society.

This personnel has to be maintained and their interest kept alive until "the millennium comes or Air Forces are disbanded" (Wing-Commander Hodson).

(3) The civilian medical organization is founded on and closely corresponds to that of a force in the field.

(4) Since public apathy is so great, and the conscience of many local authorities so dull, all efforts should be made to proceed with A.R.P. preparations with the greatest enthusiasm, energy and speed.

(5) Education of the medical profession in medical organization, gas and military surgery is essential.

## APPENDIX I.

TIME TABLE OF PERFORMANCE OF MEDICAL UNITS IN AN AIR RAID ON  
A CONCENTRATED POPULATION.

*Number of casualties to be dealt with (maximum expectation). Daylight raid by 36 machines :—*

Killed	..	..	..	1,000
Walking	..	..	..	1,000
Lying ..	..	..	..	700

*Medical units required to deal with these numbers :—*

First-aid parties	..	..	..	20	May require to be increased if the journeys are long.
Motor Ambulances	..	..	..	20	
First-aid Posts	..	..	..	4	
Casualty Clearing Hospitals	..	..	..	3	
Base Hospitals	..	..	..	2	

*Capacity of Medical Establishments :—*

Motor Ambulances, each	..	..	4 lying or 6 sitting.
First-aid posts, each	..	..	100 lying, 200 walking.
Casualty Clearing Hospitals, each			200 "beds" admitting convoys at 150 at a time.
Base Hospitals	..	..	500 beds.

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## TIME TABLE.

Air Raid .. ..	00.00 hours			
F.A. Parties arrive ..	00.15 hours			
Motor Ambulances arrive ..	00.15 hours			
F.A. Posts open .. ..	00.30 hours		should be clear by 25.00	
C.C. Hospitals			? open for treatment of minor cases	
No. 1 opens .. 00.45	No. 2 opens .. 02.30	No. 3 opens .. 05.00		
closes .. 02.00	closes .. 04.00	closes .. 06.15		
Evacuation begins 08.00	Evacuation begins 10.00	Evacuation begins 12.15		
Evacuation ends 10.00	Evacuation ends 12.45	Evacuation ends 14.15		
<i>No. 1 2nd Convoy</i>		<i>No. 2 2nd Convoy</i>		<i>No. 3 2nd Convoy</i>
Opens .. .. 10.00	Opens .. .. 13.00	Opens .. .. 15.00		
Closes .. .. 12.00	Closes .. .. 14.15	Closes .. .. 16.00		
Evacuation begins 18.00	Evacuation begins 20.00	Evacuation begins 23.00		
Evacuation ends 20.00	Evacuation ends 22.00	Evacuation ends 25.00		

If the distances from first-aid posts to casualty clearing hospitals are increased the times for transport will also be increased.

## Base Hospitals.

No. 1 opens .. ..	08.00	No. 2 opens .. ..	18.00
Received from 1 C.C.H.	10.30	Received from 1 C.C.H.	20.30
Received from 2 C.C.H.	13.15	Received from 2 C.C.H.	22.30
Received from 3 C.C.H.	14.45	Received from 3 C.C.H.	25.30
Closes .. ..	15.00	Closes .. ..	26.00

## NOTES.

A casualty clearing hospital completes taking-in in one and a quarter hours, allowing ten four-stretcher motor ambulances with a round journey of twenty minutes.

Deciding that 40 per cent of the lying cases will be operated on at the casualty clearing hospital, sixty operations will be performed.

Ten per cent of the convoy will remain, therefore 135 or thirty-four car loads require removal to the base hospital.

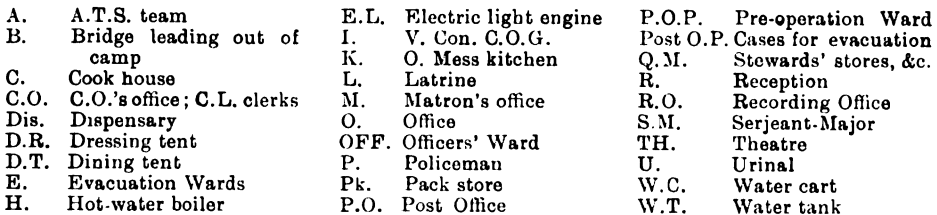
The base hospital will be some miles away and forty minutes may be allowed for the round journey. Twelve cars will be required to do these journeys each, and the evacuation will be complete in two hours.

There are 700 lying cases to be dealt with ; it is strongly recommended that, if three casualty clearing hospitals are available, convoys of 150 are sent to each in turn. 250 lying cases will therefore be held at the first-aid posts until No. 1 Casualty Clearing Hospital is ready to take in again, about ten hours from zero. Five convoys will deal with the lying cases.

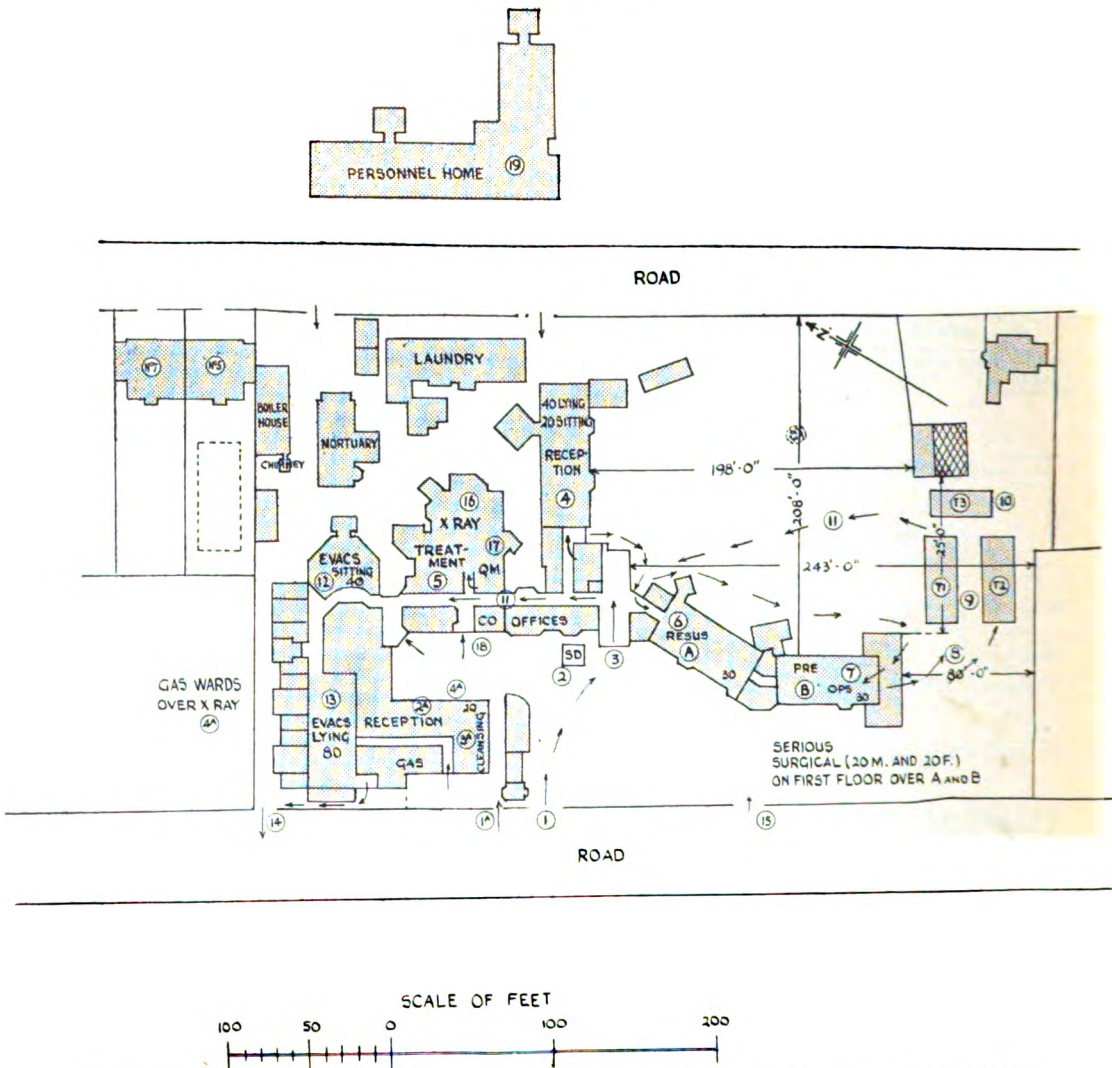
Of the 1,000 walking cases, 5 per cent will become lying and 10 per cent will require operation. These cases make up a sixth convoy to go to No. 3 Casualty Clearing Hospital.

These figures are optimistic. The personnel engaged will be new to the work, unused to working together, and staff arrangements may not be perfect. In the first raids, it will probably be necessary to add several hours to the performance time-table given above.

(No. 1 C.C.S. WALKING WOUNDED BOISCEAUX-AU-MONT, SEPTEMBER, 1918).



APPENDIX III.



PLAN OF CROYDON GENERAL HOSPITAL LAID OUT AS A C.C.H. OF 200 PATIENTS.

Accommodation of each department is indicated in figures. Names of departments are indicated thus  $\odot$ . The direction of the stream of patients is indicated by arrows.

- (1) Admission ambulances. (2) Stretcher dump. (3) Off-loading point. (4) Reception. (5) Treatment. (6) Resuscitation. (7) Pre-operation. (8) Route to theatres. (9) Theatres. (10) Sterilizing. (11) Route to evacuation and serious surgical. (12) Evacuation sitting. (13) Evacuation lying. (14) Evacuation ambulances. (15) Serious surgical. (16) X-ray. (17) Quartermaster. (18) C.O. (19) Personnel.

The C.C.H. is confined to the ground floor with the exception of two serious surgical wards on the first floor (male and female, 20 beds each).

(By kind permission of Sir Henry Berney—Architect)

## AN ALIENIST'S POINT OF VIEW.

BY MAJOR G. W. WILL, O.B.E.,  
*Royal Army Medical Corps.*

As an Alienist I come into more intimate contact with the inner lives of my patients than I would in any other branch of my profession. I get the tale of their worries and troubles—some imaginary, but many all too real. They tell me of sweethearts who are faithless; of wives who are unfaithful; of fathers and mothers who are ill, crippled, in poverty, or dying while the patient is overseas with no hope of seeing them for years and quite unable to do anything to help. The average soldier is inarticulate on paper and cannot write what he feels to his people. He seems quite unable to do anything in reply to the brief accounts of family troubles and disasters which he receives from home. They tell me, also, of the feeling of depression induced by the hopeless monotony of barrack-room life. They describe the emotional isolation of their lives, units in a machine which seems to disregard their personality. They talk, sometimes, of the indifference of officers concerned only with the battalion and regardless of the interests of the individual. They mention the occasional injustice of the N.C.O. who can never be pleased. The tyranny of the serjeant-major seems to be not wholly apocryphal.

From the patient who has recovered from an emotional episode and been returned to duty only to be again admitted I get, all too often, a story which goes something like this: "I felt all right when I went back to duty but they all knew I had been in the mental section. They called me 'pagal' and said that I was 'barmy.' I stood it as long as I could and then it got too much for me." The average barrack-room soldier, however great his virtues, has not much sympathy for mental weakness and does not hesitate to express himself. This is the result of his inherent fear of something he does not understand. He does not mean to be intentionally cruel.

I know that in one year, in India, there were some men who found their troubles too much for them and chose suicide as a preferable alternative. How many suffer from mental conflicts we do not know but we do know that some sixty cases a year are invalided from India to England. In the Annual Report on the Health of the Army for 1935 it is recorded that the total admissions for mental disease in that year were 517. In all Commands at Home the numbers were 273, in India 168. These seem considerable numbers in what is, on the face of it, a body

of carefully recruited men trained to a high pitch of physical condition and well housed, fed and clothed.

To interview me in my office there come the fathers, mothers, sisters, brothers and friends. All are distressed, some showing it by anger against the Army that has taken, they say, the best of their son "only to leave him like this"; others are bewildered and unable to comprehend; a few are philosophical and resigned; while a rare few accept their son's insanity as something already in the family and a not altogether unexpected part of their earthly troubles. I have recently been impressed by the obvious prosperity and good social position of many relatives and this may suggest that the patient is the weakling of the family. If so, why has he chosen the Army as a vocation? There is many a story behind this.

From other relatives who are unable to afford the expense of a visit come letters—now and then litigious and accusing—"I am unable to accept responsibility for my son—he was fit when he joined the Army and now that the Army has made him like this it is up to them to look after him." Many are puzzled and distressed—"Mother and I are very distressed . . . we cannot understand it as there never has been anything like this in our family . . ." There come also the revelations of long-kept secrets, the accidental discovery of which has sometimes played no inconsiderable part in the production of the patient's breakdown.

Of late there has begun to arrive a new type of letter and at interviews a new reason is suggested for the mental upset. Let me give three examples which stand out clearly as illustrating this:—

(1) A mother at an interview. A decent hard-working woman, the mother of ten living—has found life hard and works as an agricultural employee growing tomatoes—toil-begrimed hands, weather-beaten face, and crystal clear eyes with a steady gaze, a woman with personality and character. Her son is a simple-minded youth with strong hysterical tendencies. She said: "You know, Doctor, all the time I was carrying him I was working in a gun-powder factory right up to within a fortnight of his birth (January, 1917). We all had to do our bit, hadn't we? I never knew when I was going to hear that his father had been killed at the Front. Do you think that all that might have had some effect on the boy?"

(2) In a letter written by a father, an ex-Warrant Officer of a technical Corps, mobilized in 1914. He is talking of his son: "Of course, he is a War production, having been born in 1915, and you know what that means. I have no use for him at all."

(3) In a conversation with a highly educated father about his son: "I wonder if the circumstances of his birth could have had anything to do with this. He was born in January of 1915, while I was in France, and his mother was, naturally, very anxious and worried at the time."

As I was writing this I had on my desk the papers of the last twelve admissions. I find that, of these, eight were born in 1916 or 1917, and that all eight belong to that nervous hysterical type who cannot be placed in any hard and fast classification. To tie an accurately descriptive label on any one of these would be an impossibility. In mental disease where the trouble is so much that of the individual, no two men reacting in the same way, the definite labels given in the Nomenclature of Diseases are, at times, used with only approximate accuracy. In all these cases a diagnosis of "Feeble-mindedness" would not be far from the truth, but sometimes the most prominent symptom, such as hysteria, is used.

In these days the question of infantile mal-development as the result of pre-natal maternal dietetic deficiencies is attracting much attention. Great importance is placed on the presence in the mother's diet of such mineral salts as calcium, and of a due proportion of the various vitamins. Pre-natal clinics are as much for the benefit of the unborn child as for the securing of a satisfactory delivery for the mother. I do not wish to begin here a discussion on pre-natal maternal impressions and their effects on the child as evinced by markings resembling crayfish, mice, or aeroplanes, whose presence is alleged to have been determined by some maternal experience.

I do stress the importance to the child of the mother's mental state while pregnant of that child. It is only reasonable to believe that the strain, anxiety, and even fear experienced by expectant mothers during the War years should have had some effect upon the children. Very great importance must also be attached to post-natal impressions, both educational and environmental. These may be even greater than pre-natal influences. Assuredly if the soil be not good the seeds of education will not sprout, while if the environment be bad tares may be reaped instead of corn. In many cases these war-time children were born into an environment of fear and apprehension. Neither must we neglect the possible effects of malnutrition in infancy and early childhood. The combination of these factors does seem to have had some effect. In many cases we find that, on reaching adult age, there is a stopping short of perfect development. We get the slacker, the sufferer from indecision, the lack of ability to pursue a definite course and the drifter from one job to another. We meet, with curious frequency, the highly nervous boy who is afraid of blood, afraid of pain, and afraid of being teased. They do not seem to develop into clear-cut schizophrenics, although they do tend to find relief in phantasy. There seems to be something more than a neurosis or psychoneurosis, although many may be classified in either of these groups. When they come into the quiet calm of a mental hospital they usually recover and remain well just so long as they have no responsibility to shoulder. Their defect is of both affect and conation.



Another type which is met with, I think, in increasing numbers, is the patient in whom there is a definite intellectual defect. This type should always be classified as an imbecile or feeble-minded person. It might be thought that with good food, graduated exercise, regular hours and intelligent discipline, these men would improve in the Army, and it has even been suggested that the Army is the best place for them. Unfortunately for them the Army demands more than a little intelligence and also considerable initiative and a capability to assume responsibility, which latter quality the mental defective sadly lacks.

Among these various types we get many who have been called "shirkers" and "lead swingers." That many of them do tend to make the most of their symptoms cannot be denied. This has long been recognized as a common tendency in mental defectiveness as well as in schizophrenia. That they do dislike Army life is undoubted, but, make no mistake, they dislike it because of their inherent inability to cope with it. Some recognize this in themselves. In others there is a complete inability to adapt themselves to any form of social communism whatever (I do not speak politically!). Their tendency to seek a refuge from their troubles in an exaggeration of their symptoms is but a further proof of their inherent weakness. They are not malingering; that is, they are not feigning disease.

Malingering does occur, but not in the type of case under discussion. The modern soldier has got to know that if he is found to be insane he goes to a mental hospital and he does not wish that to happen. The true malingerer is much rarer than in days gone by. A recent admission who was thought to be a malingerer has turned out to be a case of dementia paranoides completely out of touch with reality, and is now being sent to a County Mental Hospital.

In a recent conversation with the Training Officer of the Royal Army Medical Corps he commented on the lack of intelligence shown by so many recruits. He said, "Some of them do not seem to be able to put enough words together to carry on an intelligent conversation." Those of us who have to correct many examination papers will probably agree; but is this defect educational or inherent? I am reminded of one patient who was admitted recently. He had tried Canada but did not approve of the Communistic tendencies displayed by his companions in relief camps in British Columbia. On his return to England he was unable to obtain employment and after several curious happenings eventually found himself in the R.A.M.C. Depot. After a fortnight he heard the Voice of God telling him that he had mistaken his vocation and to go elsewhere. This he proceeded to do without delay! That he, like many others of my patients, had mistaken his vocation was only too true, but it seems a pity that the revelation could not come before enlistment.

I would like, in conclusion, to give as my opinion that amongst our present-day patients we find many who appear to benefit as much from the visits of their chaplain as from the attention of the medical officer. All too often are we investigating and observing while the priest has been able to offer the patient a solution to his doubts, fears and worries. Man must have something outside himself in which to believe. There are some who profess to find it in their Regiment or in their Corps, but in their innermost hearts most men feel the need of God. In many of our younger soldiers religious doubts and fears play a very great part in the production of mental trouble. This aspect is frequently entirely overlooked. When I think it might do good, I do not hesitate to hand the patient over to his priest, and I have never known anything but good result.

It will be noticed that I have as far as possible refrained from giving any statistics to support my point of view. To make amends I offer a suggestion. This is: to institute a mental test on enlistment. This must needs be standardized and carried out by thoroughly trained examiners. I feel sure that many of the patients who come under my care would have been eliminated by such a test. How some of them ever came to be accepted remains a profound mystery.

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## A NOTE ON TYPHOID AND PARATYPHOID FEVER IN THE GALLIPOLI CAMPAIGN (1915).

BY ADAM PATRICK, M.D., F.R.C.P.,  
*Professor of Medicine, University of St. Andrews.*

ONE of the features of the Gallipoli campaign in 1915 was the very large amount of sickness from enteric fevers and from dysentery. Much doubt apparently remains as to the precise nature of the former. In the chapter on "The Enteric Fevers" in the "Medical History of the War" (p. 214) the writer says: "It is especially unfortunate that the severe conditions ruling throughout the Gallipoli operations made it impossible for those concerned to render or obtain as accurate information regarding the incidence of enteric as could have been desired, and definite figures as to the relative proportions of T, A, and B, their respective incidence among the inoculated and uninoculated, and on other points, are lacking. As it was not possible to examine more than a proportion of the cases by laboratory methods, the diagnosis rested in many cases on clinical evidence alone, while another element of confusion was introduced by the wide prevalence of diarrhoea and dysentery, often accompanied by fever. The results of the laboratory examinations made at home on the convalescents invalided from the Mediterranean showed how little confidence could often be placed on the original diagnosis. It was not until conditions became more stabilized and laboratories and skilled bacteriologists more numerous that greater precision was possible." Malta was one of the bases to which the sick and wounded were evacuated, and may have had about 20,000 beds. As I myself worked as a bacteriologist in Malta from October, 1915, onwards, that is during the latter part of the Gallipoli campaign, it occurred to me that I might be able, by reference to old note books, to throw some light on this point. It is an old story, but the figures might be of use for purposes of reference.

Perhaps a personal note would not be out of place here. Whilst working as a resident medical officer in one of the Glasgow fever hospitals (1910-12) I had investigated the agglutination reactions with anti-typhoid and anti-paratyphoid sera of a number of typhoid bacilli which I had isolated from patients. This had given me a great deal of practice in carrying out microscopic agglutination tests, the method then in common use, and also experience in the interpretation of results. I was sent to Malta with a number of other medical officers in September, 1915, and was posted to Cottonera Hospital as a bacteriologist early in October. The

military hospitals were full of patients from Gallipoli, and one quickly realized the prevalence of dysentery and of fevers of the enteric type. It was not only that they occurred in the medical wards to which the men had been admitted as subjects of these diseases—they were common also on the surgical side among the wounded. It was not universally recognized that paratyphoid fever was occurring, and the physicians were perplexed by some of the laboratory reports on the blood of these typhoid-like patients which expressed equivocal results of agglutination of the typhoid bacillus. When, however, the tests were carried out against paratyphoid A and B, the figures obtained were conclusive, and there was seldom doubt as to the presence or absence of one of these diseases.

Nearly all the results which I have to put forward are based on agglutination tests, although there were a few blood cultures and a few post-mortem examinations. It was not that the importance of the isolation of organisms was not recognized, but the pressure of work was great, and there was a complete lack of trained technical assistance. However, I have no doubt that the results of the Widal reactions are reliable as regards the paratyphoid bacilli. Recent inoculations against typhoid obscured the figures for the typhoid bacillus, but a little analysis clears up some of the difficulty. I did not have complete information as to the inoculation state of all the patients whose blood was examined, for a good many of them I did not myself see, but I have records of about half of them, and in all these cases inoculation had been carried out by two injections of T. I have a note that in one or two instances the man had not been inoculated, but I think these cases were rare. I am satisfied that none of the men who came under observation in this series had had inoculation with T.A.B. I do not think that this became general until 1916, after the Gallipoli experience. As a result of the T inoculation nearly every blood examined showed some agglutination of T at 1 : 100, and some showed a little at 1 : 800.

For the most part I used 1 : 800 as the test dilution. This was high enough in most instances to clear the inoculation level of T, and high enough to make positive results with A and B undoubted. From October 23, 1915, till the end of February, 1916, the number of bloods tested was 616. Of these 8 were positive for T, 97 for A, and 103 for B. A few of these were confirmed by culture—T once (growth from bile), A 7 times (5 from blood, 2 from bile), B 4 times (3 from bile, 1 from fæces and from bile). In addition, three other bacilli were grown post-mortem from bile in cases in which an agglutination had not previously been carried out, one each of T, A and B. This would bring the total numbers to

Examinations	T +	A +	B +
619	9	98	104
(Approximate percentage)	4 per cent	46 per cent	50 per cent

In a few of the paratyphoid cases there was considerable agglutination also of T, but I have disregarded this as I think it was due to inoculation. In one of these in which A was agglutinated and T less strongly, though considerably, A only was obtained from the bile on post-mortem culture. Another piece of evidence against a double infection with T and A or B is that I only once found both A and B agglutinated at 1:800 in the same patient, and both these organisms were more common than T.

Of the 9 typhoid cases, I have it noted that 6 had been inoculated, and I have no information of the inoculation state of the 3 others, among them the 2 with positive cultures from the gall-bladder. It is, of course, possible that these others may be cases merely with an unusually high agglutination titre after inoculation but the point cannot be settled definitely, and I think they were real typhoids.

The prevalence of paratyphoid amongst these patients was really extraordinary. When I found positive results so common, I examined for a short period the blood of every man admitted to hospital, and found that sometimes pyrexia which was thought to be due to septic wounds was really caused by paratyphoid. Dysentery also was very prevalent, but did not disguise its symptoms in the same way. I formed the opinion at the time, after seeing so many of these cases, that few men who had been on the Gallipoli Peninsula could say with certainty that they had not suffered from paratyphoid. Another indication came from culture of the gall-bladder in patients who had died of dysentery. I made fourteen such post-mortem examinations, and found A in one case and B in three.

We may, I think, take it that A and B infections occurred in Gallipoli in approximately equal numbers, and that paratyphoid was extremely common. T infections were relatively infrequent, and it is a fair inference that this was the result of antityphoid inoculation, as the conditions for its spread were ideal. It is interesting that, in spite of the large number of men who returned to this country after an attack of paratyphoid A, this fever should be so uncommon in Britain. In the course of consulting practice I see paratyphoid B occasionally, but the infection in any odd case of A I have seen has been contracted abroad.

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## Editorial.

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### EPIDEMICS IN SCHOOLS.

THE interim report of the Schools Epidemics Committee, appointed by the Council of the Medical Research Council seven years ago, has just been issued.

In an Editorial on experimental epidemiology we gave the conclusions by Greenwood and Topley after studying the changes in a community of mice among which diseases had been introduced. In a Special Report (No. 209) these investigators noted epidemiological resemblances to, and differences from, the course of events observed in a boarding school and recorded by Dudley in 1926, and by Dudley, May and O'Flynn in 1934. The Council thought it would be desirable to widen the study of "semi-isolated communities"—Dudley's term—and that British public schools offered opportunities for such research. Completely isolated communities were not available.

The inquiry was begun with two main objects. The first was to study the incidence of those epidemic diseases in schools which each year take a toll of child health and efficiency. The second was to see how far the lessons learnt from experimental epidemiology with animal herds could be applied to human communities. It is noted that school entry marks the beginning of communal life in which the child is exposed to herd diseases that disturb our common life. The school is peopled by children at a highly susceptible age, almost unmixed with adults, and receives every term a fresh batch of new and unsalted pupils. The herd immunity is therefore lower than that of the family in which the proportions of adults and children are nearly equal.

Most of the children observed had, however, been at a preparatory school before entering the public school, so with them it was not a sudden change from family to school, but a passage from a highly susceptible herd to a larger and somewhat more immune one. A large proportion of the children also had already been immunized by a previous attack against the more common infectious diseases of childhood.

The great majority of children in England are educated at non-residential schools and are influenced by varying home conditions and contacts during travel to and from the school. The residential schools, however, form semi-isolated communities for a portion of each year; records of diseases are easy to obtain, and the effects of any method of control are easily discerned. For these reasons the Medical Research Council appointed a Committee with the following terms of reference:

"To inquire into the prevalence and mode of spread of epidemics in residential schools, especially those believed to be spread by droplet infection, and to report on the means by which they can be prevented or restricted."

The Committee planned their inquiry in the first instance to obtain data as accurate, detailed and extensive as possible concerning the incidence and effects of the diseases falling within their terms of reference. Descriptions of particular epidemics, or fluctuations in certain sickness rates at one or other residential schools, were known to be available, but there was no comprehensive and continuous description of the events at many different schools concurrently over a considerable period of time. The Committee felt that such a description was needed before they could answer the variety of questions with which they were faced. These investigations have occupied a period of five years and are not yet complete; but the Committee thought they had gone some way towards defining problems, if not of solving them, and considered the evidence should be made available to all those concerned with this important social question. They have therefore published the interim report.

The Committee think it is desirable that there should be general recognition of the immense strides that have already been made in the medical supervision of boys and girls in our residential schools. The contrast between past and present is well depicted in the historical summary which forms the first section of this Report.

The historical notes have been written by Dr. Lempriere and the material has been received from the following schools: Charterhouse, Christ's Hospital, Epsom, Eton, Harrow, Haileybury, Marlborough, Oundle, Rugby, Repton, St. Paul's, Shrewsbury, Westminster, Wellington, Winchester.

Dr. Lempriere divides his notes into several periods, and in the notes on the period of 1800 to 1870, there is an admirable account of the health of the Royal Military College from 1809 to 1816 by the medical officer, Dr. Bruce.

Dr. Lempriere states that the original establishment was at Marlow, where the site was unhealthy, low-lying, shut in, and in close contact with the poor, and as the cadets were often lodged in separate houses, they were constantly exposed to various infections. A new college at Sandhurst was built in 1812 and proved much healthier. The cadets all lived in, the bedrooms only held five, and there was an allowance of  $7\frac{1}{2}$  feet per bed. The following extract is quoted from Dr. Bruce's report: "There is prompt medical attendance so that under ordinary conditions the disorders of the cadets seldom assume a very dangerous or aggravated character." It was noted that routine games and exercise had a very salutary effect.

Of the sick admissions, fever was the most important. There were

three types: (1) intermittens; (2) conti; (3) mitior. The last was by far the largest group and corresponds to the present P.U.O. or feverish chill.

Records were carefully kept. In the eight years, with a maximum population of 360, there were 154 cases of febris mitior (or P.U.O.); 933 cases of cynanche tonsillaris, i.e. septic tonsillitis; 100 cases of ophthalmia; 101 cases of rheumatismus (over 70 at Marlow); 311 cases of catarrhus; 54 cases of otalgia; 34 cases of colica.

With the exception of rheumatism and possibly ophthalmia, this might well be a record of a public school of to-day.

The records of the public schools during this period compare very unfavourably with those of Sandhurst. Winchester, in the early and middle nineteenth century, suffered considerably from sickness, mainly scarlet fever. In 1843 the school was dispersed on this account, and in 1846 half the inmates were down with fever. Unhealthy new buildings, overcrowding, and bad drainage, were said to be the cause of these outbreaks.

At Eton in 1812, the diet was very meagre. The earliest meal was at 10 a.m., consisting of half-a-pint of milk and a 1d. roll and butter. Dinner was bread and mutton: pudding was served once a week on Sunday. The accommodation was disgraceful; there were not enough beds for the juniors, some of whom had to sleep on the floor.

There was no water laid on to the college, and washing was done at a pump in the yard. Sore throats and scarlet fever were rife.

At Westminster the conditions were appalling. The dormitories were very cold and infested with rats, the floors were decayed and some finally collapsed. The feeding was most inadequate.

The conditions at Christ's Hospital were investigated by Lord Brougham's Committee, which sat from 1819 to 1827. The presence of the all-pervading ringworm and the poverty of the diet were the chief causes of complaint. The *Lancet* commission stated that "Christ's Hospital is fast becoming, if not already, a pest house and a public nuisance."

The first two-thirds of the nineteenth century represent the dark ages of the public schools. In the latter part of the century and the twentieth century up to the present time, numerous and great changes were made, with the result that the local conditions in schools were incomparably better than during the first half of the last century.

The Public Schools Commission was established in 1864. Valuable as were the reports of commissions in calling attention to defects, the real causes of reform arose from the growing knowledge of hygiene, sanitary science and bacteriology.

The foundation of the Medical Officers of Schools Association in 1884,



by Dr. Alder Smith, of Christ's Hospital, and Surgeon-General George Evatt, was an outstanding landmark. The objects of the Association were first to secure the co-operation of medical officers of educational establishments and to co-ordinate their efforts, and secondly to discuss such subjects as "school hours, periods of study, recesses, the bedding and lodgment of pupils, the isolation of infectious diseases and quarantine; questions of the structure of class rooms and school equipment, gymnastic training and field sports, over-pressure and cramming."

Though the Association has been invaluable to the school doctor, it has failed in one of the main objects of its foundation, for though the severity of some of the infectious diseases has lessened, the incidence of the exanthemata in general has not diminished.

It is remarkable how few medical records have been kept in schools even in the past twenty-five years. These records are almost entirely confined to those schools in which resident medical officers are appointed. It is impossible to over-estimate the important part played by certain school doctors—Fergus of Marlborough, Dukes of Rugby, Haig-Brown of Charterhouse, and Armstrong of Wellington, whose work resulted in great improvement in diet, hours of work and general environment. The development of a medical press was also a great influence; any serious outbreak of infectious disease in a school received unflattering attention. Another important factor was the development of a knowledge of hygiene by parents who were increasingly composed of classes more susceptible to the teaching of Chadwick, Farr and Simon than the landed classes.

Dr. Lempriere writes that though in a statistical sense recent changes of incidence have not been wholly reassuring, we must not forget that owing to the more human and understanding regimen in public boarding schools, children are now sent to them who, a quarter of a century ago, on account of delicacy, would have been educated privately. Moreover, any statistical comparison of the present with a past even so recent as that of sixty years ago, is hazardous, for the reason that the data are now more accurately recorded, and we may not conclude that what was not reported two generations ago did not, in fact, happen.

The Committee appointed by the Medical Research Council, acting in conjunction with the Ministry of Health, first met in July, 1929. A letter was sent by the Chairman to the head masters and head mistresses of several public schools, explaining the nature of the inquiry and asking for their co-operation. As a result, twenty-one boys' schools and ten girls' schools agreed to participate in the inquiry.

A system of recording was set up, and an attempt was made to secure that one person in each school should act as recorder.

Great differences were found in the environmental conditions. In

some schools houses were entirely separate and the boys only met the boys of other houses in class, games, gymnasium, and the swimming bath. In other schools there might be four houses in one large building. Dormitories, even in the same house, varied in floor space and ventilation. In some dormitories the floor space was only half that in others. In class rooms the floor space per pupil might vary from 13·0 to 20·5 square feet in the same school.

The difficulty of making any epidemiological comparisons or deductions in the presence of these differences of environmental conditions was very great and can be readily appreciated.

At the outset of the inquiry it was intended that the bacteriological work should be confined to the examination of material from cases of otitis media and pneumonia, and the work was to be in the laboratories of the Ministry of Health. But later on Dr. Griffith wished to extend his observations on hæmolytic streptococci, and large numbers of swabs were examined from cases of tonsillitis and scarlet fever.

At the outset of the investigation the total population of boys under observation was 10,671, of which 1,482 were in the naval schools, 689 in the day schools, and 8,500 in the public boarding schools. For the girls the population at risk at the outset was 3,253, of which 458 were in the day schools and 2,795 in the boarding schools; in the late summer the population of girls was increased to 3,629.

In all schools except one, new entrants were admitted every term, but the proportion of the whole population formed by new entrants was far higher in the Christmas term than in the other two terms.

At one time or another 22,166 boys and 7,600 girls took part in the inquiry, the period of observation varying from one to fifteen terms.

The Committee draw only tentative conclusions from this experience, which they consider too limited in time and scope. They did not obtain important findings capable of immediate application, and refrained from drawing inferences and making recommendations which might prove unwarranted in the light of further observation.

The environmental conditions of girls' schools being different from those in boys' schools, data for boys and girls were kept separate from the outset.

The average termly nasopharyngeal attack rate was much higher for the girls than for the boys. This was considered to be due to girls being kept under stricter surveillance, and on that account more likely to be kept out of school, rather than to girls being more susceptible to minor respiratory affections. In the case of influenza, which would be regarded equally seriously in either sex, the average term attack rates were nearly equal: while in the case of colds the average—term—attack rate for girls was 22·6 per cent compared with 5·6 per cent for boys.

The common cold was one of the most common causes of lost time ; including influenza with it in a single group of naso-pharyngeal infection, among girls 53 per cent and among boys 43 per cent of lost time was on account of respiratory affections.

Excluding influenza, the attack rates of naso-pharyngeal infection exhibited a rise in the early weeks of the term to a maximum in the third or fourth week, then a rapid fall with a tendency to a secondary rise in the tenth week. Herd immunity is lost during the holidays, and intimate mixing at the beginning of term leads to an epidemic of colds ; this is followed by a temporary immunity which soon wanes and another outbreak of colds occurs towards the end of term.

The question of seasonal influence of disease was studied in some detail ; epidemic influenza was confined to the Lent term almost entirely. Otitis media, pneumonia, sinusitis and rheumatism among boys were all common at this season, and were aggravated at times of epidemic prevalence of influenza and measles. The Christmas term was never a time of epidemic prevalence in either sex. Gastro-intestinal diseases showed their highest incidence in the Christmas term in both sexes. It was found that epidemics of the various infectious diseases differed considerably in their ability to work themselves out before the end of term. Half the outbreaks of measles might be considered to come to a natural conclusion ; no epidemics of German measles and only a small proportion of mumps, chicken-pox and scarlet fever outbreaks could be said to be terminated before the holidays began. It is impossible to explain this phenomenon on a theory dependent on the number of susceptibles exposed to risk. There is no obvious reason why epidemics of measles should tend to behave differently from those of chicken-pox, since the proportion of susceptibles is approximately the same—about 30 per cent—for these two diseases.

It is considered excusable to regard individuals who have not been protected by an observed clinical attack of measles, German measles, chicken-pox or mumps as susceptible to these diseases, although evidence is accumulating that it is possible to acquire an immunity to measles by exposure to infection during an epidemic without showing signs of clinical disease ; but it is regarded as inexcusable in view of the information accorded by the Dick reaction to regard as susceptible to scarlet fever all those who have not passed through an attack ; it is better to regard them as "not previously attacked." Unfortunately the Dick test has proved unreliable in the hands of some workers who have used it with the idea of immunizing the positive reactors : still, as in the experience of the Committee scarlet fever, when left to its own devices, has never attacked more than 3 or 4 per cent "of the not previously attacked" in any outbreak, it is considered that the advantages of artificial immunization

against scarlet fever in a public school are insufficient to compensate for the labour and disability incurred during the process.

The Committee found that analysis of seven pairs of measles epidemics gave support to Stock's theory that immunity could be acquired by exposure to infection without signs of clinical attack. In four pairs of outbreaks of German measles there was some evidence, though less convincing, that the same phenomenon was at work.

The Committee are unable to throw any light on the question why an epidemic spreads; they state they know nothing of the factors favouring rapid dissemination of cases on the one hand, or limitation to a few cases on the other. German measles was the most incalculable disease, in that half the outbreaks did not spread appreciably, but in some instances the disease exhibited invasive powers only equalled by their experience of influenza.

The Committee found no evidence in favour of the common belief that chicken pox confers immunity against zoster.

The data as regards influenza showed there was no evidence of an actively acquired immunity lasting as long as one year. In fact in two pairs of epidemics analysed those who had influenza in one year were more, and not less, likely to contract the disease in the next year than their companions who had passed through the first epidemic without being attacked. These findings do not exclude the possibility that an attack confers an immunity of short duration. A study of the epidemic which occurred in the Lent term, 1933, revealed the fact that pupils who had suffered from influenza in the Christmas holidays were significantly less liable to an attack than those who had escaped the disease in the holidays.

Recent work has shown that a ferret which has recovered from an experimental attack of influenza is temporarily immune, but within six months susceptibility is usually re-established.

Examination of the record cards of the entire population at the beginning of the investigation showed that half the boys and nearly half of the girls had had their tonsils removed: a yearly census showed that these proportions were rising, until at the end of 1934 they had increased by nearly 6 and 7 per cent respectively.

The Committee considered that it was important to discover whether this mass attack on a normal structure of the body was justified. They studied the incidence of naso-pharyngeal affections, such as influenza, colds, sore throats, etc., in boys and girls, with and without tonsils, and found no significant difference in the attack rate in the two groups, and certainly no evidence that tonsillectomy resulted in a diminished incidence of these infections.

An examination of the pre- and post-operative history of a group of 364 boys whose tonsils were removed during school life, showed that before

tonsillectomy the attack rates were distinctly higher than the average; after tonsillectomy the attack rates approximated closely to the expected rates in equivalent age groups of all the schools combined, showing a definite improvement in health. Though they realized the value of the operation in selected cases, the Committee doubted whether the majority of the operations performed to-day are the result of true discrimination, rather than of routine ritual.

When the Committee considered serious illnesses like otitis media and pneumonia, which are not subjected to local influences like minor respiratory diseases, they found great differences between the two sexes, boys suffering twice as frequently as the girls from otitis media, two and half times as frequently from pneumonia, and eleven times as frequently from acute rheumatism.

This state of things may be due to a sex difference, but it is also probable that it may be the result of girls being kept under more strict supervision and probably isolated earlier than boys. There is also less close contact in girls' schools, where sleeping accommodation is usually in the form of cubicles or separate bedrooms. Cubicles are rare in boys' schools, where large open dormitories are the rule. The Committee consider that it is of the utmost importance to discover the underlying cause of the difference between the two sexes so that boys may be freed from the heavy incidence of diseases which cause serious disability and even death.

Girls suffered more severely from appendicitis than boys: in the former about 50 per cent more cases and 10 per cent more operations. There was no evidence that removal of the appendix in either sex had any influence on subsequent sickness rates.

The data on tuberculosis were scanty and attention is drawn to the rather high incidence of pleurisy and pleural effusion in boys over 15. The Committee do not know what proportion of boys subsequently develop tuberculosis; they believe that routine X-ray examination at six to twelve months intervals after the initial attack of pleurisy might lead to earlier diagnosis and prompt treatment of the disease, with consequent improvement in prognosis.

The bacteriological work was carried out by Dr. F. Griffith, of the Ministry of Health. His observations raise certain questions of epidemiological interest. At one school there were six separate invasions, with different types of *Streptococcus pyogenes*, each giving rise to throat affections. Each type appeared suddenly and after a time died out, leaving traces of the invasion in the presence of chronic carriers. A similar sequence of events occurred at other schools. Dr. Griffith discusses the reasons for the disappearance of the epidemic strains. Several factors are probably concerned, but the relatively low infectivity of those scarlatinal convalescents who remain streptococcal carriers, points to some

change in the organism. Dr. Griffith thinks that, in order to remain highly infective, the streptococcus must be passed from one susceptible throat during the period of the throat's acute inflammation to another, and when such throats are no longer available streptococci now surviving in convalescent throats lose their infectivity. One conclusion which emerges definitely from these observations is that infections with individual streptococcal types represent distinct epidemic entities. Further, infection with one type leaves no complete immunity to another. The dangerous periods are the Christmas and Lent terms: in only two instances has a new epidemic strain appeared in the summer term.

In 139 cases of otitis media and mastoid disease the causal organism was streptococcal in origin in 57·5 per cent, and pneumococcal in 42·4 per cent. The types concerned were those responsible for outbreaks of tonsillitis and pneumonia; and both otitis media and mastoid disease are often the clinical evidence of the spread of streptococci and pneumococci of special epidemic potentiality, and are not commonly due to autogenous infection already existing in the upper air passages.

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## Clinical and other Notes.

### A CASE OF LEPROSY IN A BRITISH SOLDIER.

BY CAPTAIN G. F. HARRISON,  
*Royal Army Medical Corps.*

LEPROSY occurs so rarely amongst soldiers of the British Army that a medical officer confronted with an unusual skin lesion might be forgiven for not at first thinking of it as a possible diagnosis. In fact, there have



FIG. 1.—Studio photograph taken in August, 1936.

been but two such cases in the last ten years; in one the diagnosis was not made until seventeen years after he had left the Army, and the other was a boy who enlisted in India and had been born and brought up there. No excuse, therefore, seems necessary for publishing the present case, as the title alone may act as a reminder that rare as such cases are they do

occur, and the earlier the diagnosis is made and treatment started the better is the prognosis.

A Signalman, aged 27, was admitted to the Military Isolation Hospital, Aldershot, on February 28, 1938, the diagnosis of leprosy having been confirmed bacteriologically that day. His history was as follows: He was born in April, 1911, at Fort Blair, Andaman Islands. His mother, one brother and two sisters were healthy, as was his father when last seen in 1931. He could not recollect any member of the household having



FIG. 2.—Showing the lesions on the face and neck.

been afflicted with any skin or other disease. From 1913 to 1920 he lived in Jhansi (India); from 1920 to 1927 he was in Saugor (India), and from 1927 to 1929 in Allahabad, U.P. After this he stayed for four months in Calcutta with his stepfather, who was healthy, and then in Shillong until he joined the Army in June, 1930.

In the Royal Corps of Signals he served in Jubbulpore (till September, 1932), Rawalpindi (till January 1, 1936), Mohmand Operations (1935). During this period he was three times on leave in Peshawar.



Before the apparent onset of his present condition he had enjoyed excellent health, except for one month in hospital in 1931 with bronchitis, the result, he thought, of having become chilled after a vigorous game. He used to represent his unit at various sports.

In January, 1936, he sailed for England and was here until September 14, 1936, when he sailed for Palestine. During the latter half of the voyage he used to sunbathe each day. He noticed one day some reddish spots on the inner side of the upper part of each thigh which he knew had not been there before. These spots, which at first were only a millimetre or two across, very gradually grew until they were about five millimetres or more. Gradually they turned a brownish red colour, while at the same time further groups of spots appeared above and below the original site, each spot going through exactly the same slow changes. The leopard-skin effect thus produced was enhanced by the sallowness of his normal skin. The spots did not itch or cause him any inconvenience other than that resulting from their odd, unsightly appearance. He first reported sick in October or November, 1936, and subsequently while he was being kept under observation.

So slowly did the lesions advance that it was not until March, 1937, some six months later, that the spots reached the level of his waist. Continuing their steady advance up the body, they reached the face in July, 1937. He appeared not to have noticed the essentially nodular nature of these "spots" until they had reached his face. Here they did not begin as red "spots" as had all the previous lesions, but as "lumps" of no special colour other than that of his normal skin which in that site was well tanned.

Since the first appearance of the lesions in September, 1936, he had felt perfectly fit and well. There had been no "colds" or feverish attacks. He had played games, attended dances, and, in fact, appeared to have suffered remarkably little inconvenience from the disease.

On December 14, 1937, he returned from Palestine, and after taking some leave in England returned to duty in this country, and was admitted to hospital on February 28, 1938, as already stated. By this time the diagnosis of leprosy was an obvious one to make, and it was confirmed quite easily in the Leishman Laboratory by Lieutenant-Colonel L. Dunbar, R.A.M.C., who found a fair number of lepra bacilli in a smear made from some nasal mucus, and large clumps of lepra bacilli in a smear made from nicking a small nodule chosen at random under the chin.

His condition on admission to hospital was as follows: Temperature and pulse-rate were normal. His face was completely covered with thick nodules of the same colour as that of normal skin. Some thickening of the forehead and a thickened nose gave him a rather leonine appearance which was not so well marked as it may be in an advanced case. The

evil expression given to his face by the disease was offset by his pleasant smile; fortunately he was a cheerful fellow and had retained a sense of humour. There was no loss of eyebrows, the eyes were unaffected, and there was no apparent nasal discharge. Tongue and throat were normal, and palpation of the lobules of the ears revealed no abnormal thickening. Rogers and Muir (1925) state that the auricles are perhaps more constantly affected than any other part of the body.

It is notable that in spite of the widespread lesions on the face the scalp was not palpably affected. This accords with the usually accepted belief that leprosy lesions seldom or never occur in the scalp.

The arms, trunk and legs were fairly symmetrically covered with what at first sight might have appeared to be brown macules of varying sizes and shapes. But by using oblique lighting on the skin, or by lessening the tension of any selected area of the skin, the nodular nature of these brown patches was clearly demonstrated. Palpation confirmed that they were nodules in the skin. They were well marked on the arms, back, buttocks and thighs. Diffuse streaks of brown pigmentation appeared from under each anterior axillary fold. Neither the palms nor the soles were affected, and there was no ridging or other abnormality of the finger or toe nails. There was some induration and quite well marked prominence of the left nipple. This is a very common feature of this type of the disease. The right nipple was not affected to quite the same extent.

His voice was slightly husky, but the patient himself was surprised when questioned on this point and appeared not to have noticed any change in his voice. As the voice is stated often to be affected owing to laryngeal involvement, it is probable that the slight huskiness of voice detected in this patient was not normal for him, but that the onset had been so insidious he had not noticed any change.

As a general rule the more the skin is affected the less are the nerves involved, therefore it was not expected in this case with such a widespread involvement of the skin that much evidence of nerve affection would be found. Thus, the cranial nerves were normal. Muscle tone and power were normal. All reflexes, superficial and deep, were normal and equal. No thickening of any nerve was detected. There was no pain, no hyperæsthesia, and no anæsthesia other than that to be mentioned. There were no ulcerative lesions or blisters, and no area of depigmentation of skin was seen.

Testing every inch of his body surface with a wisp of cotton wool revealed only one patch of anæsthesia, about four inches long by three inches wide, over the region of his right patella. In this area there was a large plaque of very thick coarse skin raised above the level of the remainder of the skin and darker in colour than the rest. Rogers and Muir recommend that this very important test for anæsthesia should be performed

with a spill of paper and that the patient should be made to point with one finger to the place where he thinks he is being touched, this method being more likely to lead to the detection of a small patch of anæsthesia than the method normally used to perform this test. In discussing whether or not to test for the presence of other forms of sensation, they point out that it is best for diagnostic purposes to limit the search to loss of superficial touch as this makes the only clearly defined demarcation between nerve and skin leprosy. Thus it is possible, as was demonstrated later in this case, for the patient accurately to localize the site of a light touch and yet not feel any pain when this area of skin is pricked with a needle.

The Wassermann and Kahn reactions of the blood were negative. The blood sedimentation-rate was three millimetres in one hour (Westergren).

#### DISCUSSION.

Considerable differences of opinion have existed as to the length of the incubation period, but more recently the tendency has been to regard this as being shorter than was originally thought. In eighty-four cases collected by Rogers it averaged two years and eight and a half months. As this disease may start insidiously, unobserved by the patient owing to the painless nature of its onset, and may be latent for several years, it is often impossible to say what the incubation period has been in any given case. Thus, in the present example no definite evidence whatsoever was obtained of the patient having been in contact, sexually or otherwise, with a leper, and so the incubation period is unknown. It is possible that it was longer than the average owing to the excellent health which this patient had enjoyed throughout his life.

It is not proposed to discuss details of drug treatment, nor were any special drugs ordered for him during the short time he was a patient in hospital. It is of interest to mention, however, that before he was admitted to hospital he had received four intramuscular injections of ten cubic centimetres of his own blood, during the course of three weeks. The apparent result of this treatment was a very marked reduction in the size of the nodules on his face, so that the patient was able to state that whereas before this treatment started he had been "unrecognizable," his face now bore some resemblance to its original state before the disease began. Two further similar injections were given whilst he was in hospital, and further improvement could be seen in the lesions on his face and elsewhere. It is presumed that the results apparently produced by these injections indicated that the patient had acquired some degree of resistance to the disease. The normal blood sedimentation is also of interest in that it gave confirmatory evidence that a good degree of general resistance existed.

I am indebted to Major W. J. F. Craig, R.A.M.C., for information regarding official statistics of the disease amongst British troops, and to Major-General F. D. G. Howell, D.S.O., M.C., K.H.S., for permission to send this case for publication.

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NEISSERIA CATARRHALIS ISOLATED FROM THE BLOOD-  
STREAM OF A CASE OF BENIGN TERTIAN MALARIA.

BY CAPTAIN W. M. E. ANDERSON,  
*Royal Army Medical Corps.*

THIS was a typical case of malaria in which a possible cause of the abnormal features was demonstrated.

The patient, an officer, aged 23, was admitted to the British Military Hospital, Sialkot, on September 23, 1937, complaining of headache and general malaise. He had been in India for about seven months, and gave a past history devoid of any medical interest. A few days previously he had returned from a stay of two months in a malarious district. Up to the previous day he had been perfectly fit, but that evening, feeling unwell, he had gone to bed early. Next morning he took his own temperature and found it to be nearly 104° F. He was seen at his own quarters, and admitted to hospital.

On admission he complained of no special symptoms except a general malaise.

*Physical Condition.*—A healthy looking, well built man. Face flushed. Conjunctivæ injected. Teeth and throat normal. Pulse 88, of slow, full type. There was no abnormality of the cardiovascular, respiratory or central nervous systems. A "three finger" spleen was present.

A blood-film revealed benign tertian rings. He was put on fluids, and during the day was given 20 grains of quinine. That evening at 10 p.m. the temperature rose to 104·6° F. Aspirin 10 grains and a simple diaphoretic mixture were administered, and induced a satisfactory perspiration, following which the temperature dropped to 103·6° F., and later to 102·6° F. The following day 20 grains of quinine were given by the mouth, and that evening on the temperature rising to 104·8° F., 12 grains were given intravenously. On each of the three succeeding days 40 grains were given by the mouth. On the morning of the sixth day in hospital the temperature had fallen to 99° F., and the routine quinine-plasmoquine course was commenced.

The remainder of the illness was uneventful; the spleen gradually diminished in size, being impalpable on the fourteenth day in hospital.

During the period that large doses of quinine were being administered, a careful watch was kept for toxic symptoms, but beyond two days partial deafness, the patient suffered no untoward effects.

On the third day of fever, blood was taken for culture and agglutination tests. This was repeated six days later.

The Widal, Weil-Felix and Felix tests revealed nothing abnormal on September 26, 1937 (the figures in parentheses are those of the Felix reaction). The last T.A.B. inoculation was eight months previously, T = 0, A = 70, B = 35, TO = 0 (50), OXK = 35 (35), OX19 = 0 (17), OX2 = 0 (0).

October 2, 1937. T = 50, A = 125, B = 50, TO = 50 (80), OXK = 25 (50), OX19 = 0 (25), OX2 = 0 (0).

From the blood culture taken on September 26, a small Gram-negative, non-motile diplococcus was isolated. This resembled a *Neisseria catarrhalis*, and did not ferment glucose, lactose, mannite, dulcitol or saccharose, and did not produce indol.

A subculture of this organism was submitted to Major H. J. Bensted, Officer-in-Charge, Enteric Laboratory, Kasauli, who confirmed it as being *N. catarrhalis*.

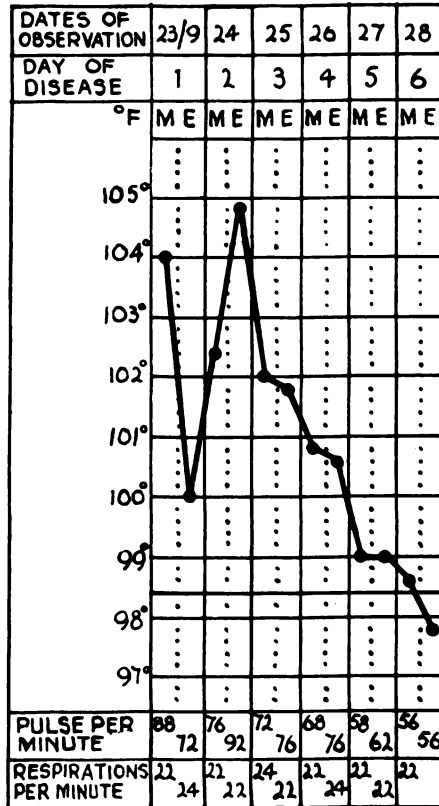
An investigation of the patient's serum for the presence of antibodies was carried out. Serum from blood taken on the tenth day of fever was put up against a suspension of the organism. This was prepared with 1/1000 HgCl<sub>2</sub> (as recommended by Lieutenant-Colonel Bridges), and the organism was found to emulsify readily. An unfortunate property of this organism is its propensity for forming unstable suspensions, and in this experiment the control tube showed agglutination. A second specimen of blood was taken, and with the serum obtained from it, the test was repeated. This time the control was clear, and agglutination up to 250 was seen. A similar result was obtained with serum taken five days later (on the seventeenth day of the fever). Parallel tests on these three serums were carried out against formalinized suspensions of the organism, and titres of 80, 50 and 50 respectively were obtained, without any evidence of auto-agglutination. A point of interest was that with the first suspensions flocculations formed, while with the formalin the appearance was that of fine granules.

Throat swabs were taken on several occasions, and small Gram-negative diplococci were isolated. These however proved to be glucose fermenters. In this connection the Cruickshanks may be cited; they say that the fermentations of *N. catarrhalis* are liable to variations.

A pathogenic rôle has been claimed for the *N. catarrhalis* by various authorities. In the Continental literature, there are reports of four cases

of meningitis, two of them purulent, and one of acute conjunctivitis, in all of which the *N. catarrhalis* was incriminated, and American workers have reported the organisms as causing meningitis, endocarditis and epidemic conjunctivitis. Pfeiffer and Ghon regard them as capable of producing influenza-like symptoms.

Although it is, admittedly, by no means uncommon in febrile conditions to isolate organisms of doubtful pathogenicity from the blood-stream, it is



considered not entirely unreasonable in this case to ascribe a pathogenic rôle, of a secondary nature, to the *N. catarrhalis*. No meningeal symptoms were noticed, but the clinical features might, in some ways have been described as "influenzal-like," although this term is rather a vague one. The paradoxical serological findings may, perhaps, be explained by the organism's auto-agglutinating properties, which are possibly more marked in mercurialized suspensions (although agglutination was actually present in the control tube on only one occasion). The case, as the clinical notes and temperature chart show, was a definitely atypical case of benign tertian malaria. Certain of these "atypical" cases, notably those of "cerebral"

malaria, have been explained as being caused by a mechanical blockage by the parasites of the capillaries supplying important organs, but it is conceivable that, in many others, a secondary infecting organism, such as the *N. catarrhalis*, may be present as a cause of the abnormal features. Such is believed to have occurred in this case, but as the matter is still rather hypothetical, the terms "septicæmia" and "bacteraemia" have been carefully avoided in these notes.

My thanks are due to Lt.-Colonel C. Popham, Commanding, British Military Hospital, Sialkot, for permission to send these notes for publication, and to Major H. J. Bensted, M.C., for his help and criticism of the laboratory findings.

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## Travel.

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### A TRIP TO MOROCCO.

BY COLONEL M. J. WILLIAMSON, M.C.

SPAIN at war has made a great difference to life in Gibraltar. It is not good for man to live in a small crowded island for months at a time, doing the same things and living in the same environment day after day. Transport is so easy these days that movement has become essential to our idea of normal existence. Spain used to be the natural outlet for officer and man. The lovely cities of Andalusia were within easy reach and the motor car hummed along good roads with the old-world beauties of Spanish towns as an attractive goal and a complete change from the embattled circumference of the grim old Rock.

We are not completely battened down. The Nationalist Government have granted permission to go as far as Algeciras to the West and Torremolinos (70 miles) on the East. In between we can still play polo and golf at Campomonte, and hunt over the hills and cork woods. Many R.A.M.C. officers will be glad to hear that these steep, stony hillsides still make the horses blow, and dodging the cork trees gives the riders a thrill just as it did of yore.

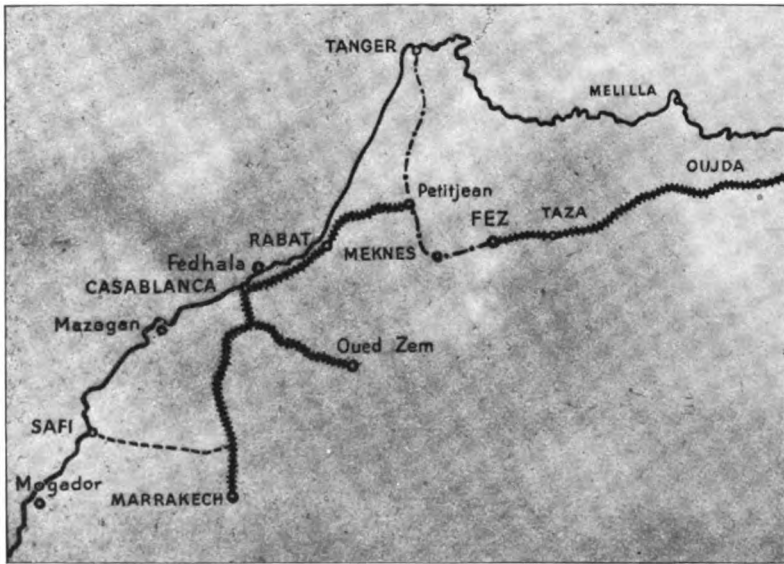
All this preamble is merely to show what a good thing it is that Morocco holds out a beckoning hand from across the Straits when leave is felt to be a necessity for the good of the soul.

We set off for a fortnight in January, doing the thirty miles to Tangier in the little Gibel Dersa, which steams across three times a week.

Tangier is the best starting point for a visit to French Morocco from this part of the world. A glance at the map will show that Casablanca is really more central. It is not, however, so accessible from Gibraltar, and besides, we wanted to look at Tangier.

We were not tremendously impressed with this cosmopolitan town. It has a beautiful climate and bristles with hotels built for the benefit of sun searchers and income tax dodgers, but the bazaars are poor, and it poured with rain, so we only stayed long enough to make arrangements for our trip and left it without regret. To enjoy living in Tangier a house on the hill outside is the method of choice, and there are some charming villas on the high ground near the golf course some four miles out.

We had not brought a car as advice on the matter was so conflicting that we put our trust in the train service. The main reason against the car was that the road cuts across the Spanish Morocco border, where the



anti-car brigade said that hold-ups of a couple of hours or so might be expected. I think these people must have attempted to go through during the siesta time, when hailing an official from his couch is unthinkable. If the holiday mind is above worrying about an odd hour and perhaps a personal search, a car in Morocco has many attractions. The roads are good and comparatively empty, so that pace is easy and safe. I shall certainly take a car if I go over again.

The trains did us very well indeed, however, and we set out at 9 p.m. for Marakesh, our furthest south point, in a wagon-lit of exceeding comfort. It is true we were turned out at Casablanca to change into another train at 6.30 a.m., but that only meant stepping across a platform. As we neared Marakesh, the flat, well-cultivated land changed to a barren countryside with outcrops of stone-covered hills. Looking ahead we got glimpses of the snow-clad Atlas mountains, and suddenly found ourselves



running through a great date palm grove, which is a feature of the countryside just north of Marakesh.

If you discuss Marakesh with other travellers, inevitably they will open with "And didn't you think the Mamounia was marvellous?" They are talking about THE hotel. There are others, but they can be dismissed with a shrug of the shoulder. It seems all wrong that a place which is supposed to be more Eastern and Arabian-nightish than Baghdad, should have its glories, in the minds of many, overshadowed by the luxurious appointments, the magnificent outlook, the cuisine and the excellent service of a modern hotel. However, you do spend a lot of your time in it, and to wake in the morning, step on to your balcony and see the sun rise over the Atlas Mountains is one of the unforgettable sensations of the town.

The mountains, seemingly so close, are seen across the orange groves of acres of hotel gardens, and make a vivid contrast with their wintry sides gleaming rosy in the dawn, to the parched, sun-dried land which surrounds the city.

Marakesh consists of two main parts, the native city and the new French city. The latter houses the Foreign Legion, native troops, and the attendant families. It has no points of interest to the ordinary tourist.

The native city is a great straggling place, surrounded by a formidable wall. Inside its circumference are gardens, palaces and bazaars (local name Souk), linked up by all sorts of roads, ranging from the broad boulevard running to the main square (La Place Dje Maa-el-F'na) to the tiny, blind-walled alleys of the bazaar quarter.

The town dates back to William the Conqueror's time, but its heyday was in the sixteenth and seventeenth centuries. A guide is a necessity, but his activities have to be checked. His main idea is to conduct the visitor to a succession of Moorish houses, some of them fine old places, where all manner of rugs, leather work, and jewellery and antiques are displayed for his delectation. The big idea is that purchases should be made. On everything bought the guide demands and gets a substantial rake-off from the shop owner. So it is essential to have a clear idea of what is to be shown and allow no divergences unless, of course, the desire is the acquisition of Eastern products for the home.

There are some fine specimens of Moorish palaces and tombs to be seen, but what interested us were the Souks and the main square.

The Souks are a maze of narrow streets with matting strips overhead to keep off the sun. The streets are lined with shops much like those of the Peshawar Bazaar; each street has its own trade and all are crowded. Nobody took the slightest notice of us unless we showed interest in the wares displayed in any particular shop when everybody else rushed to

display something better than the thing we were looking at. It was the people that were worth coming to see. The Arab in his burnous and leather slippers was the commonest male type, but all sorts of costume, picturesque or merely dilapidated, clothed many varied types from the light-skinned Jews to the coal-black African negro. The ladies were for the most part extremely closely veiled with a tight white face-covering leaving the narrowest slit for the eyes. Even the fat and aged hid their charms. The edicts of Mustapha Kemel have cut no ice with this part of the Moslem world.

Eventually we struggled out into the bright sunshine of the great square. It was afternoon and the morning markets had all closed down to give place to the amusement side. The great open space was crowded with people in little groups. In the centre of each group professional entertainers of some sort were busily doing their stuff. The first we met was a bearded veteran declaiming a tale to an open-mouthed audience who hung on his words. The guide said, "He tell story from Arabian Nights." Perhaps so. Next we struck a snake charmer, then a group of musicians, then dancers of various sorts and all had their clientèle. We were shown an old slave dance as a star turn, but a stamping crowd of oldish negroes with beaded headdresses failed to stir us to any wild enthusiasm even when blood-curdling yells were thrown in to give the show a spice of excitement.

In the hotel that night we met Arnaud Massey who, at the age of 60, spends his winter months as golf professional to a local Pasha, who is such a golf enthusiast that he has conjured up an eighteen-hole course with grass fairways and greens from the arid waste just outside the walls. The secret of this seeming miracle is, of course, unlimited use of irrigation water. Into the ethics of that we did not delve too deeply but greeted with joy the chance of playing with the famous old golfer. His wife was an Edinburgh lass and he knows Scotland well. His golf is still grand to watch and he enlivened the round with tales of Andrew Kirkaldy and Ben Sayers, told with homeric gales of laughter and emphasising bangs with his free arm on my shrinking person.

Rabat was the next place we visited. It is the seat of the Government of French Morocco and is quite a different type of town to Marakesh.

It is on the sea at the mouth of a river facing the famous pirate haunt of Salé, standing grimly behind its city walls, across the estuary.

The old town of Rabat is crowded in behind its sea wall along the river front; behind this to the south is the main town with its government departments, grouped round the Residency in a picturesque garden setting, its hotels, cinemas and broad, well planned streets. The Sultan has a palace of imposing extent on the fringe of this part of the town. His guards looked most formidable in red plus eights and red braided jackets. A long-carved sword dangled at their sides and formed, as far as could be seen, the main armament.

A large proportion of this main town is comparatively newly built and has sprung into existence since the French arrived in 1912. A separate and entirely French town, sited clear of the old town, is one of the ideas of town planning which the French have held to in most Moroccan cities.

In Rabat they have laid out a magnificent new residential quarter on rising ground south of the main town. The Avenue de la Victoire is the central road of this new town and its proportions are worthy of the name. There is a pleasing air of space everywhere. Charming villas of individual design set in their own gardens border the road, a beautifully laid out Jardin des Plantes adds grace to the main Avenue and altogether the place is so attractive that my wife toyed with ideas of hanging up the hat there in the aftermath of Service.

I will not bore you with descriptions of the sights of old Rabat, but they are well worth spending a morning over. We did them justice and then set off for Meknes.

In the hotel bar at Tangier I had met a returning traveller who had told me that I must on no account miss seeing Volubilis, to which it would be easy to drive from Meknes. He gave the recommendation with the reservation that his profession (he was an architect) might have coloured his judgment of the desirable, but that he had never seen such mosaics in any city of the olden days.

We followed his advice and, after a fifteen mile drive, found the excavated remains of the town spread over a rounded hill overlooking a wide valley. Many of the houses had walls three or four feet high and the lay out was plain to see. The better class houses must have been pleasant places to live in. The dining rooms were roomy and were floored with mosaic. Our bar friend was quite right, these mosaics are wonderful with their brightly coloured fish and birds redolent with life. Leading off the dining room, in some houses, was a little passage way to the household bath with stone pipes in situ for water carriage of hot and cold water. There was a hot water system undoubtedly, as the pipes connected up with an obvious furnace room next door.

The town was complete with its Forum, a triumphal arch, fountains and temples. The Latin inscriptions (dates *circa* 100 A.D.) on the stones were so clearly cut that they would have delighted my late classical master.

There are, of course, no complete buildings in the town as, down through the years, the place has been pillaged for stonework, and later we saw many Roman pillars incorporated in the gateways and buildings of old Meknes. Enough, however, remains to stimulate the imagination and to give a very good idea of Roman living conditions of that time.

Within a mile or so of the ruins is Moulay Idriss, a quaint Moslem

town of 7,000 souls perched on twin hills. Moulay Idriss was a Sultan of the twelfth century and a true descendant of the Prophet. He is buried in the saddle between the hills, and his tomb throws such an odour of sanctity over the town that no Christian is allowed to live within the walls. We clambered up the narrow dirty streets to the top of both hills under the ægis of an amusing young guide whose one desire was to see London. We had some close-ups of native life, but appreciated the beauties of the place to the full only when we saw it, bathed in the setting sun against a background of barren hills from across the valley.

Next day we devoted to seeing Meknes. It is a city of character. The man who gave it its individuality was Moulay Ismael, a great Sultan of the seventeenth century. He had great ideas and a desire to make Meknes the Versailles of Morocco. He went about it in a truly Eastern way by collecting 60,000 Christians, mainly the proceeds of the piratical exploits of the Salé Rovers. He imprisoned these unfortunates in an enormous underground prison, whence they were driven out to work every day. If they objected to the daily toil they were walled up inside the prison next day, a grim spur for the activities of the rest.

It is not surprising to hear that when he asked for the hand of Princess Conti of France in 1682, the lady declined the perilous honour.

All that remains now are the ruins of this imperial dream, but the grandiose proportions of the palace, the gateways, the stables and the granaries are witnesses to the magnitude of his conceptions. The massive stables, walled and arched to stand for centuries, were built for 12,000 horses, and everything else of this Imperial city was planned on the same scale.

As we left, our two-horse victoria drove us on to a green field. "Prison," the driver said. We walked across the sward and were joined by a dusky, trousered maiden, carrying an enormous key. She led us to a corner where some narrow stone steps descended to a massive door. She swung it open and disclosed a dimly-lit cavern. We went in to find a huge vaulted cellar lit by circular holes in the roof. The uneven earthen floor contained thousands of cubic feet, but 60,000 humans must have had many a well-grounded complaint to lay before the local D.A.D.H. when he made his monthly visit.

The Villa Indigène and the new French Meknes we left for another day and hurried on to Fez. A seven kilometre drive from the station in the new French Fez gave us a good view of the closely-packed walled city on the gentle slopes of the Oued-Fez valley. The road led along above the walls, winding and twisting until a final turn fetched up at a gate in the city wall. Just inside the gate was the Palais Jamai, the famous Fez Hotel. It was once a vizier's palace, and in its conversion to a caravanserai, the tiled, Moorish beauties of the architecture and the cushioned divan

atmosphere of the public rooms have been left to delight the cosmopolitan visitor.

From the roof of this excellent hotel the flat roofs and minarets of Fez are seen crowding on the slopes below, and up the hill away to the south. Fez is close around, and a few steps down the terraced garden leads to an archway opening straight into the teeming bazaars of the old town.

A guide is absolutely necessary in these narrow tortuous streets. The blind walls are high and there is no landmark to give a hint of direction in the maze of streets and bazaars which look so much alike.

The native life and the bazaars are the interesting things to see in Fez, and there they are in concentrated form and well worth the viewing. Mosques (outside only), medersas (schools) and gardens are the other attractions, but are really all part of the quaint mosaic of the town.

We spent two mornings buffeting our way along the crowded streets, dodging the panniered donkeys and side-stepping the persistent salesmen. It was enough. The third day we walked straight up into the surrounding hills and were rewarded by a marvellous view of a rolling country with a background of high hills. Everywhere the people seemed friendly, and it was hard to believe that General Lyautey was penned up in Fez by the Berbers less than twenty years ago. They got to within 100 metres of his house before Colonel Gourand got in some effective counter offensive work and relieved the situation.

Fez was our last port of call, and reluctantly we boarded the train for Tangier *en route* for Gibraltar.

For a sojourner in Gibraltar a visit to Morocco should be natural if history has any appeal. Morocco and Spain have been linked up through the ages, and a tour through the ancient strongholds of their power cannot fail to interest. The note of western civilization superimposed by the French, besides being impressive in its scope and town planning, adds much to the comfort of the traveller and makes French Morocco a very pleasant place in which to spend a leave.

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### Current Literature.

MASTERMAN, A. T. **Air Purification in Inhabited Rooms by Spraying of Atomizing Hypochlorites.** *J. Indust. Hyg. & Toxicol.* 1938, v. 20, 278-88, 1 fig.

A sodium hypochlorite solution containing sodium chloride was atomized and the rate of progress of the vapour followed by means of a series of Bunsen burners placed at increasing distances from the atomizer. The yellow sodium flame indicated when the vapour reached the burner and also how long it persisted in the neighbourhood. The rates of travel varied in different experiments, but in one experiment quoted, in which the

sprayer was worked at four pound per square inch air pressure and in which a hypochlorite solution containing 0.05 per cent available chlorine was used, the spray travelled twenty feet in under two minutes and persisted for over twenty minutes. Experiments were carried out by exposing Petri dishes containing nutrient agar at different parts of a room or factory in which numbers of people were working, and measuring the degree of air purification that occurred following a single spraying by the decrease in the number of colonies developing. In different experiments it was found that the plate count one to five hours after spraying might show a reduction of 90 per cent on the initial count. The proportion of active chlorine needed was not determined precisely, though in one experiment a concentration of 0.14 milligramme of active chlorine per cubic foot appeared to yield satisfactory results. Assuming that the chlorine was in the form of hypochlorous acid gas, this would represent a concentration by volume of one part in six millions. No discomfort was caused to any of the occupants of the room or factories. G. S. WILSON.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

MAYERS, MAY R., & SILVERBERG, MABEL G. **Skin Conditions Resulting from Exposure to Certain Chlorinated Hydrocarbons.** *J. Indust. Hyg. & Toxicol.* 1938, v. 20, 244-58.

The heat and moisture-resisting properties and non-inflammability of chlorinated naphthalenes and diphenyls make them invaluable in the insulation of wire and the manufacture of electric condensers. Such halogen compounds have long been known to cause "chloracne," the literature of which is summarized. A survey was made of nineteen factories making electrical condensers and three making insulated wire. In the former, chloracne was found among the workers employed at the finishing operations of soldering and testing condensers that had been impregnated with chlorinated naphthalene. This impregnation was being carried on in closed ovens with no escape of fumes. The finishing processes were not adequately protected with exhaust draughts to remove fumes; here exposure took place. Six out of thirty-one workers had severe acneform eruptions, showing pustules, papules and large comedones; four cases were milder. The eruption appeared on the face, along the mandible, on the neck and the extensor surfaces of the arms. In contrast to ordinary acne, the eruption was intensely irritating; the workers called it "blackhead itch." The period of employment before it appeared varied from a few weeks to one and a half years. It disappeared in two or three months after removal from exposure. Some family predisposition was noted. Patch tests gave negative results. Prevention lies in carrying away from the air all fumes generated when the chlorinated naphthalenes are volatilized by heating or flaming during dipping, pouring and soldering operations. The workers should wash carefully after using cold cream to remove any wax-like film deposited on the skin. E. L. COLLIS.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

LAHY, J. M. **Psychology Applied to Educational and Social Problems in a French Rural District.** *Occupational Psychology*. 1938, v. 12, 116-33.

Fifteen years of experiment in methods of vocational guidance in a crowded working-class quarter of Paris have revealed that vocational guidance cannot be reduced to the simple allocation of young people to employment on the basis of chance relations which may hold between their own tastes, ambitions, and the state of the labour market at a given time. The aim should be the gradual adaptation of individuals to the occupations which are to be their life's work.

Since Paris for many reasons was not suitable for the experiment of working a psychological centre, a rural district, Mitry-Mory, about sixteen and a half miles from Paris, was chosen. It has a population of about seven thousand inhabitants and a school population of about thirteen hundred children.

The first task was to sort out the pupils of the elementary schools into normal and backward children, the latter to have special instruction. It was found that, by applying the same methods as in the schools of Paris, about 57 per cent of the Mitry-Mory children were suspected of psychiatric disorders compared with only 10 per cent of the Paris children. Some of the children considered by the teachers to be backward proved to be normal intellectually, their backwardness being due to other causes, either social, physical or temperamental.

The really mentally backward, judged by intellectual tests, were tested for other capacities, e.g. memory, concentration, psycho-motor ability. In many cases it was found that these tests gave a different distribution, showing that the possession of compensatory ability could in some way make up for intellectual defect, and should therefore be used in education.

Although these investigations showed that there were in Mitry-Mory a higher percentage of backward children than in Paris, it must not be concluded that the population of the village is inherently inferior. The social environment must also be considered. In Mitry-Mory the standard of life is poor, there are no playing fields, no community life, no organization for leisure. Hence the children have no opportunity of developing their mental activity outside school, with the result that their vocabulary is very poor. This condition, however, need only be temporary.

The problem is a sociological and economic one, but much can be done by the formation of a psychological centre, which should consist of medical, psycho-technical, social and educational sections. Mitry-Mory is believed to be the first place in France to possess an organization providing such facilities.

[A very interesting and suggestive experiment.]

MAY SMITH.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

## Reviews.

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### PRACTICAL BACTERIOLOGY, HÆMATOLOGY AND ANIMAL PARASITOLOGY.

By E. R. Stitt, M.D., Sc.D., LL.D., Paul W. Clough, M.D., and Mildred C. Clough, M.D. Ninth Edition. 1938. Pp. xiv + 961. London : H. K. Lewis and Co., Ltd. Price 30s. net.

The ninth edition of this useful book has now made its appearance and is certain to be welcomed by workers in clinical laboratories both at home and abroad. The science of bacteriology has made such rapid advances in recent years that it is only natural the authors should find it necessary to re-write much of the text and to increase slightly the size of their new volume.

In the space allotted to a reviewer it is impossible to give a detailed criticism of a book such as this which is a mine of information, and it is only possible to refer to a few points selected at random.

The classification adopted follows largely the fourth edition of Bergey's "Determinative Bacteriology." This is not an official classification and bacteriologists await the day when stability will be reached in bacteriological nomenclature.

The book is again divided into four parts—Part I, Bacteriology ; Part II, Hæmatology ; Part III, Animal Parasitology ; Part IV, Pathological Examination of the various Fluids and Organs ; and in addition there is a lengthy Appendix. In this edition the chapters on Apparatus, Culture Media and Staining Methods have been transferred to the Appendix, and the sections dealing with chemical examinations of the blood and urine, kidney and liver functions to Part IV. This re-arrangement is an improvement and makes the style more even.

The filtrable viruses are considered in the light of recent research and work on the primary ætiological agent of influenza is clearly outlined. The chapter dealing with Rickettsia infections has been re-written and mention made of the work carried out by the British Army in India on the Typhus Group of Fevers.

The Appendix contains a section on laboratory procedure useful in diagnosis. Only the more important conditions are considered, but the section is indexed by diseases and should be of assistance in the selection of appropriate tests.

The book caters for the needs of the worker who may not have access to well equipped libraries, and a great deal of information detailing laboratory procedure together with the interpretation and diagnostic significance of the various tests is presented under one cover.



The authors are to be congratulated on producing such a highly comprehensive and valuable book. The volume is a handy size and can be recommended to those who are called upon to work in a clinical laboratory.

L. T. P.

**IDEAL WEIGHT. A PRACTICAL HANDBOOK FOR PATIENTS.** By W. F. Christie, M.D. 1938. Pp. xii + 111. London: William Heinemann (Medical Books), Ltd. Price 5s. net.

As the author states this book has been written primarily for stout people, who while continuing their ordinary daily activities are slowly reducing weight under medical advice and supervision. It sets out the salient features of a reducing régime in simple language that can be easily followed by those with no special medical knowledge.

The nutritive value of foods in common use is given and useful hints on how to prepare suitable dishes are included. Tables of food values are available thus enabling changes in the diet to be made without upsetting the total calorie consumption. The book runs to a little over 100 pages and should be of considerable help to members of the general public who are interested in the problems of adiposity.

**EMERGENCY SURGERY.** By Hamilton Bailey, F.R.C.S. Third Edition. 1938. Pp. 852. Bristol: John Wright and Sons, Ltd.; London: Simpkin Marshall, Ltd. Price 50s. net.

The production of a third edition of this excellent work is a sure testimony to its popularity. The text has been revised and some of the sections rewritten. A number of illustrations, several in colour, have been added. The increase in size is small, ten pages.

This is a really useful account of the treatment of the chief surgical emergencies and will constitute an exceedingly helpful guide for the isolated surgeon. The chapters on the abdomen, urinary tract and infections of the hand are perhaps particularly good.

The only chapter that calls for some criticism is that on amputations. The diagram on p. 261 is surely out of date, and the advice that all possible bone should be saved in the femur, radius and ulna is not borne out by experience. The resulting long, ill-nourished stumps are a source of trouble to patient and artificial limb-maker alike. A well performed Syme's amputation is by no means always "lasting." The statement that the Petit's tourniquet can be applied by a novice may be true but it can be a very dangerous appliance. Also in the so-called "Guillotine" amputation it is practically always possible to have skin flaps of some kind, or anyhow to avoid dividing all the tissues at the same level of the limb.

The book is a handy size, beautifully got up and illustrated and should prove a most valuable asset to the library of surgeons in the Services

J. W.

**GLAISTER'S MEDICAL JURISPRUDENCE AND TOXICOLOGY.** Edited by John Glaister, M.D., D.Sc., Barrister-at-Law. Sixth Edition. 1938. Pp. xiii + 747, with 107 illustrations and 8 plates. Edinburgh : E. and S. Livingstone. Price 25s. net.

The sixth edition of Glaister's Medical Jurisprudence and Toxicology has now appeared under the editorship of Professor John Glaister. The present issue of this work retains much of the original character which has gained for it a well-merited and firmly established place among British books on this subject.

In a work such as this, which is concerned with the relationship of medicine to every department of science, it is not easy to select particular detail for comment.

In the section which deals with Medical Jurisprudence special mention may be made, however, of the excellent description of blood-grouping and its medico-legal application ; the tests for drunkenness ; the spectroscopic examination of the blood, and the use of the ultra-violet light, particular reference being made to lamps of the Hanovia pattern which have proved so useful in the detection of seminal stains.

In the section on Toxicology, among the many poisons described detailed consideration has again been given to carbon-monoxide poisoning, and reference has now been made to the Hartridge Reversion Spectroscope as a method for determining quantitatively the presence of this gas in the blood.

Since war gases have now become a menace to the civil population, a chapter has been included outlining the agents most likely to be encountered. The main features of these chemical substances are described and the treatment of casualties resulting from exposure to these noxious agents summarized in a clear and practical way.

The book is well illustrated and will be a valuable help not only to the student as an introduction to the study of this vast subject, but also to the teacher and practitioner.

L. T. P.

**FEVERS FOR NURSES.** By Gerald E. Breen, M.D., Ch.B., D.P.H., D.O.M.S. 1938. Pp. viii + 199. Edinburgh : E. and S. Livingstone. Price 5s. net.

This small book of under 200 pages is based on lectures delivered to nurses in London County Council's Infection Hospitals Service during the past four years. Section I deals with bacteria, the transmission of infection, natural and acquired immunity and serum reactions. The methods of treating serum reaction are given, but no mention is made of prevention by the administration of calcium. In Section II a clear description is given of the observations to be made by a nurse on receiving a new case, the general principle of nursing fever patients, and the methods of isolation. Section IV-XII describes the infectious diseases separately and concisely.

The course of each disease is tabulated with the complications which may be expected. The various tests used and the treatment of each case are carefully explained. In dealing with oxygen administration (page 96) the view is expressed that "oxygen through a funnel, or even an intranasal catheter is largely wasted." This statement regarding intranasal administration is surely not in accordance with present day ideas; it has been proved that bilateral nasal oxygen given through small valve tubing is not only efficient but also a comfortable method for the patient. Lastly, operative measures necessary in fever hospitals are described. A few questions are given at the end as a guide to the standard of the examination. This book should be of great value to nurses studying for the Certificate in Fever Nursing.

MYOCARDITIS (THE ST. CYRES MEMORIAL LECTURES). 1937. Pp. 152.

London: Eyre and Spottiswoode (Publishers), Ltd. Price 10s. 6d.

The St. Cyres Lecture on the subject of Myocarditis was founded in 1926 by the late Dorothy, Viscountess St. Cyres, in memory of her husband. This book is a collection of six of these lectures. The first is on some general aspects of Myocarditis by J. Strickland Gordall delivered in 1927. This is followed by Professor K. F. Weuckeback's discourse on Heart and Circulation in Tropical Avitaminosis (Beri-Beri), a subject of considerable interest at the present time owing to the recent work on vitamin B in the treatment of this condition. Dr. R. O. Moon next delivered the lecture in 1929 on some observations on diseases of the myocardium. The fibrosis of the heart was the subject of the lecture in 1930 delivered by Dr. John Cowan. The last, on certain aspects of coronary thrombosis, was given by Dr. John Hay.

These lectures were delivered some years ago and so are not quite up to date with some of the recent advances in cardiology; they are, however, well worth perusing.

## Notice.

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### BRITISH MEDICAL ASSOCIATION EXHIBITION, PLYMOUTH.

JULY 18 to 22, 1938.

THERE was an extensive display of fine pharmaceutical products by Burroughs Wellcome & Co.

We are informed that much interest was manifested in "Tabloid" Brand Sulphonamide-P, the sulphanilamide preparation for oral administration, which is rapidly increasing in importance as its therapeutic value gains greater recognition. In an ingenious arrangement of illuminated photomicrographic transparencies, the specific chemotherapeutic effect of sulphanilamide upon the hæmolytic streptococcus was demonstrated. In addition, the clinical use of sulphanilamide in such conditions as meningococcal meningitis and *B. coli*, *Pr. ammonia* and gonococcal infections of the genito-urinary tract was shown pictorially.

A wide range of "Wellcome" Brand Sera, Vaccines and Serological products, prepared at The Wellcome Physiological Research Laboratories, Beckenham, Kent, was on view. Of outstanding importance in this section was the "Wellcome" Brand Refined Diphtheria Antitoxin-Globulins, which combines the advantage of increased concentration (4,000 Ehrlich units or more per cubic centimetre) with reduced protein content. It should be noted that "Wellcome" Brand Concentrated Diphtheria Antitoxin-Globulins is still available.

Another important exhibit was "Wellcome" Brand Insulin—a product prepared with pure Crystalline Insulin—together with "Wellcome" Brand Protamine Insulin (with Zinc)—Suspension.

"Wellcome" Brand Calcium Mandelate Compound aroused considerable interest. This preparation lacks the disagreeable taste characteristic of sodium or ammonium mandelate, and possesses a ready miscibility, two advantages making greatly for ease in administration.

With its consistently high vitamin B<sub>1</sub> content assured by biological assay, "Ryzamin-B" Brand Rice Polishings Concentrate, another important product, offers dietary reinforcement for patients of all ages, and is of particular value in the many nutritional disorders of childhood. "Ryzamin-B" is a clear, golden-brown, syrupy preparation, which is palatable and readily taken by children.

Specimens of "Tabloid" Brand Nicotinic Acid, a product which has been introduced for the treatment of pellagra, were on view.

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### EDITORIAL NOTICES.

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**EFFECTS OF MECHANIZATION ON EVACUATION.**

BY LIEUTENANT-COLONEL T. B. NICHOLLS,

*Royal Army Medical Corps.*

THE suggestions made by Major F. M. Richardson, R.A.M.C., in his letter in the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS for July, 1938, raise some very important points.

It will be of interest to consider first how the present arrangements and constitution of medical units came into being, and then to discuss the principles that underlie our methods of evacuation.

These are developments from the past and are the legacies of horse transport and hand carriage.

At the time of the Boer War, the field medical units were bearer companies, and field hospitals. This was found to be an inefficient arrangement, and after the experience of this campaign, the bearer companies and field hospitals were amalgamated to form field ambulances, while a new unit, then called the casualty clearing hospital, was introduced. These arrangements were still based on horse transport and hand carriage, the slowness of which necessitated attention to the wounded on the long passage from the R.A.P. to the casualty clearing hospital. Hence the institution of the A.D.S. and M.D.S., where patients could be put into fit condition to withstand the slow, jolting journey to the C.C.H., and where they could wait until the transport arrived. Hence also a theory that

is still held by many, which is rank heresy in the present day of M.T. This theory is that you must take the doctor and attendants to the patient and not the patient to the medical attendants. To implement this idea, the suicidal policy of pushing the A.D.S. as far forward as possible resulted, with the consequent casualties among medical personnel which, at the end of any great war, is practically irreplaceable, and the infliction of further wounds on an already wounded man.

This opinion is no longer tenable or even justifiable. The motor ambulances can work well ahead of the A.D.S. so that the bearers have a short carry and the casualty arrives more quickly.

In this connexion, one misses the "light" motor ambulance of the Great War establishments. This was so useful for such forward work that one can only lament its disappearance.

Under the present arrangements, the casualty can have no fewer than seven changes of transport:—

- (1) Collected on stretcher by regimental stretcher bearers.
- (2) Transferred to field ambulance stretcher at R.A.P.
- (3) Placed on wheeled stretcher carrier at bearer collecting post.
- (4) Placed on motor ambulance at forward car post.
- (5) Unloaded at A.D.S.
- (6) Unloaded at M.D.S.
- (7) Transferred to M.A.C.
- (8) At last arrives at C.C.S.

These breaks of journey are a relic of the horse and hand days, and are quite unnecessary.

The patient can be evacuated direct to the C.C.S., which has taken on more and more of the treatment of casualties formerly carried out in field ambulances, and all clerical work can be done there, where it is much more likely to be accurate than in the often cramped and disturbed accommodation usually available at the M.D.S.

The question of the administration of anti-tetanus serum which was one of the main duties of the A.D.S. or M.D.S., no longer applies, since the troops will already have been inoculated.

It is remarkable how small a percentage of wounds require re-dressing after they have been attended to at the R.A.P. Those that do require attention can, in the vast majority of cases (uncontrolled hæmorrhage and severe shock excepted), quite well wait until they reach the C.C.S. In fact, it is better to leave the first field or shell dressing rather than to disturb it and re-dress the wound under conditions of doubtful asepsis.

The writer had experience of this direct evacuation from A.D.S. by M.A.C. to C.C.S. in several battles in the Great War. It proved a most satisfactory arrangement, and the casualties greatly appreciated not being

re-dressed and transhipped. The returns were made out by field ambulance clerks attached to the C.C.S., each of whom dealt with casualties from his own division only.

If these ideas are tenable, we come to the following conclusions :—

(1) That the A.D.S. should be equipped as lightly as possible, that it be regarded mainly as a collecting station and be termed "Advanced Casualty Collecting Station," and that no treatment, beyond the administration of morphia and the arrest of hæmorrhage and profound shock and so forth, be undertaken.

The writer has recently seen photographs of a most imposing A.D.S. formed by collecting a number of lorries together, connected by acres of tarpaulin. On showing this to a Gunner he exclaimed, "Gosh! what a target." Reluctantly one must admit that no display of red crosses would protect such a prominent object of the landscape from destruction by those subscribing to the doctrine of "Shrechlichkeit."

It is, moreover, a tactical mistake of the first order to expose the transport of a field ambulance to a destruction which effectively removes its most important feature, mobility.

(2) The M.D.S., as such, disappears entirely, as there is no need whatever for the casualty to halt.

(3) As a consequence, the A.D.S. or Advanced C.C.S. is cleared by the M.A.C. direct to the C.C.S., thus avoiding transshipping and the organization of a divisional motor ambulance group and car park.

It does not involve removing the motor ambulances from field ambulances. They can work in with and under the control of the M.A.C. They will still be required to relieve bearers by working forward from the A.D.S., and for collecting sick from bivouac and line of march.

(4) It frequently happens that, even under existing conditions, the field ambulance can clear the battle ground more rapidly than the C.C.S. can deal with them.

The abolition of the "Time Lag" at the present M.D.S. will render this more pronounced.

In my experience the C.C.S. is understaffed, and to remedy this and to accelerate the dealing with casualties some of the personnel can be withdrawn from headquarters of field ambulances and added to the C.C.S.

This would increase the mobility of the field ambulance as there would be less personnel to be carried in the three-ton lorries.

Here arises the reflection—Why have two types of field ambulance at all? The equipment and personnel of the cavalry field ambulance and the mechanized field ambulance could be standardized on a scale suitable to the former, with the addition of three-ton lorries and stretcher bearers when functioning with the latter.

This proposal would greatly simplify matters—one set of equipment, one war establishment for both types of field ambulance.

One has the feeling that the mobile field ambulance has too much equipment and the cavalry field ambulance too little.

Again with the disappearance of the M.D.S. the war time constitution of field ambulances could be re-introduced. From the O.C.s point of view it is much more convenient to have three self-contained sections than two companies. It makes reliefs more easy on the well-known principle “Two in the line and one in reserve.”

If detachments are necessary, the temporary loss of a section is less crippling to a unit than the loss of one company.

The re-introduction of the three sections, as opposed to the two companies, would render the unit more mobile. At present we are supposed to move our personnel in two “lifts.” One wonders if this would ever work out; sending three-ton lorries to the rear against the enormous stream of mechanized traffic moving to the front is none too easy, and we are likely to be deprived of the services of the second “lift” just when they are most required.

Another point in favour of reverting to three sections is that in the event of gas cases one section could be made to take over and deal with all such.

(5) The C.C.S. is completely devoid of any motor ambulances. In these days of bombing of back areas there are bound to be casualties for which no ambulance transport is provided—as the Non-Divisional Field Ambulance attached to Corps will probably have all it can do in the Corps area.

At present there is no provision for dealing with casualties from the masses of transport further back than Corps area. Here, perhaps, we may revive the old controversy of the mobility of the C.C.S. It should surely, under present conditions, have its own transport, even if only for the light section.

In passing, one may note how little provision for the treatment of burns exist in the authorized scales. Millions of gallons of petrol are in transport, and one explosion will lead to many burns.

(6) It is time, especially since the Royal Artillery have done so, to revise our nomenclature.

There are still many people who confuse hopelessly a field ambulance with a motor ambulance and, indeed, in common speech “ambulance” means nothing but a vehicle.

Could we not term our divisional medical units “Medical Regiments,” as is done in the United States Army, which would obviate any such confusion, or if this term is objectionable, “Field Company, R.A.M.C.,” might serve.

One medical regiment, divided into three companies (the present field ambulance), would also remove the deep-rooted idea in the minds of many that field ambulances are brigade troops and under the command of the Brigade Commander.

The foregoing ideas are put forward mainly as a basis for discussion, and it is hoped that the correspondence on this interesting, and indeed vital subject, initiated by Major Richardson, will not die of inanition. There must be many officers who have practical experience and other theories which would be interesting to all of us.

Kipling has said "*Transportation is Civilization*"—we may say that "*Transportation is Evacuation.*"

---



## WAR NEUROSES.<sup>1</sup>

BY MAJOR H. A. SANDIFORD, M.C.,  
*Royal Army Medical Corps.*

### INTRODUCTION.

THE War Neuroses form a group of nervous and mental diseases which include hysteria, neurasthenia, and mental troubles of many kinds.

There is nothing new, produced by war *per se*, as regards the causation of these diseases which are seen equally in civil life. They are important from the military point of view, because :—

- (1) They occurred in large numbers in the Great War, and may possibly occur in larger numbers in future wars unless steps are taken for their prevention.
- (2) They render a soldier inefficient, or less efficient, or enable him to avoid his duty with impunity.
- (3) They are to some degree "contagious," in that nervously unstable men, on seeing such cases occur alongside themselves, may imitate their example.
- (4) The subjects of these disorders may find themselves faced with a charge of malingering, cowardice or desertion.

### NATURE OF CASES INCLUDED IN THE WAR NEUROSES.

A. Concussion—some of these cases, about 5 per cent only, were suffering from the effects of concussion due to having been "blown up."

B. Emotional disturbances—in some cases these disturbances occurred suddenly, especially in individuals who, by their constitution, character or mental powers, were likely subjects for nervous or mental troubles. Others of these emotional disturbance cases were slowly developed, as a result of prolonged and terrifying experiences.

C. Cases of nervous or mental exhaustion occurred as a result of prolonged strain and hardship.

D. In some of the cases of neurosis all three factors—concussion, emotional disturbance and exhaustion—were involved.

Here I would like to say a few words about the concussion cases. Concussion, of course, is due to a shaking up of the nervous system and may occur equally well in a car accident, as on the battlefield. Some of the cases recover quickly and completely, but other cases may, on recovery from the concussion, produce the symptoms of a neurosis, more especially cases in which compensation is in question, or, in the case of battlefield concussion, the result of the neurosis is escape from further fighting.

<sup>1</sup> A lecture delivered to Officers, R.A.M.C., Aldershot Command, Winter Training.

Again, many cases of neurosis occurring on the battlefield *allege* they have been "blown up." It therefore becomes very necessary (on occasions) to establish whether or not a patient has been "blown up," and an Army Form W.3436 was used in the Great War to communicate between the Specialist Medical Officer in charge of the patient and the Officer Commanding the man's unit. Evidence as to "Exceptional exposure to shell fire" or of "blowing up" was required from the man's unit, and this evidence is of vital importance in helping to establish the patient's true diagnosis and his claim to sympathetic consideration.

#### NOMENCLATURE.

The conditions which have been present in cases of "War Neurosis" include psychoneuroses, such as anxiety neurosis, psychasthenia, neurasthenia, hysteria, together with functional psychoses, e.g. dementia præcox; also psychoses accompanying organic diseases and various grades of mental deficiency.

I would like you to remember, however, first that many of the cases were simple cases of physical and mental exhaustion and hardly attained the dignity of a label; and secondly, that the introduction of a catchword such as "shellshock" for these conditions did untold harm in the Great War. "Shellshock" was a bad name for these conditions, since in 5 per cent only of the cases could actual exposure to the explosion of a shell be considered to be a cause of the patient's symptoms. As a rule recovery took place, and no neurosis was left when the effects of the concussion due to the shell burst had passed off.

In about 15 per cent of the cases there was exposure to shell burst and recovery from the concussion, but the patient developed a neurosis which he probably would have done, sooner or later, without the shell-burst.

In 80 per cent of the cases there was no connexion at all between the neurosis and shell explosion—many who had never heard or seen a shell said they had "shellshock," and this leads me to a second reason why such a term should never have been introduced.

When the term had become popularized, soldiers were apt to *expect* the onset of the new mysterious disease, thus undermining their mental resistance and paving the way for its occurrence. "Shellshock" became the glib excuse put forward at court martial for cowardice and desertion, and the marked sympathy of the public with "shellshock" cases would no doubt have been bestowed elsewhere, had it been generally realized that many of these cases were purely hysterical in nature.

So much for "shellshock"—let us see to it that the term is buried and never dug out in future.

#### SIGNS AND SYMPTOMS OF NEUROSIS.

The actions and behaviour displayed by cases vary very considerably with the various types: mixtures of the types produce an even greater



array of symptoms. I have no intention of reciting to you the detailed signs and symptoms of the various diseases which may be included in the war neuroses, but it would be useful, however, to give you some idea of what these cases look like in the initial stages and how they behave.

The following are descriptions by various eye-witnesses :—

After an unsuccessful trench raid scores of young men were seen—some of them stupid, dreamy and silent, others excited with twitching limbs.

In the trenches men may crouch low in cover, starting at every gun report or shell burst—here the face may be drawn, the voice low and the limbs tremble.

In a barrage men may sit down, violently trembling, weeping or silent, staring or with tightly closed eyes and incapable of walking unaided.

Others, especially young and inexperienced soldiers, may be seen terror stricken with fear written on their faces, pupils dilated, eyes staring, hands tremulous, blue and sweating.

The above symptoms are the emotional reactions of fear and normally disappear on removal of danger.

Various paralyses, aphasia, amnesia and anæsthesias may appear later if such cases are sent to hospital.

Here is another illustration : Two officers and a battalion orderly were proceeding along a communication trench and were shelled badly. The officers stood it quite well, but the man simply collapsed. Brought to the aid post he had a terrified expression, cold face, sweat pouring off the body, was unable to speak and trembled all over.

Here is a description of men who were temporarily non-effective : “They were trembling ; sometimes apparently had difficulty in speaking clearly ; could not collect their thoughts ; had unsteadiness of gait ; often appeared as if the worse for alcohol ; imagined they were worse than they really were ; made no effort to get fit ; gave the impression that they were very frightened.”

Again insomnia, nightmares, melancholia, depression, blindness, hysterical fits—all these were seen in these classes of neuroses.

#### CONTAGIOUSNESS OF NEUROSIS.

Neurosis may be contagious as the following example shows : “About forty men with three N.C.O.s started to leave the trenches after a big enemy mine explosion in which some were killed. They reached the regimental medical officer who refused to recognize any of them as suffering from any medical disability. He promptly took their names and marched them back to the front line and handed them to the Company Commander. The men subsequently did well.”

I have seen exactly the same spread of hysteria in civil life, when on one occasion it was my pleasant duty to treat some fifteen to twenty female shop assistants who flooded the out-patients' department after several shelves, loaded with innumerable garments, etc., had collapsed in

the shop in which they were employed. Not one of them was physically injured.

#### SIGNS OF INCIPIENT NEUROSIS.

It is possible in some cases to observe a change in the behaviour of men which should lead a good company officer to consult forthwith the medical officer. Such signs as the following :—

The wild fighting type becoming quiet and morose, the sullen type becoming excited and talkative, the careful man becoming reckless.

An officer must know his men's characters to observe such departures from the normal.

Another type of man who should be watched is the brooding, introspective, self-analysing man who is always estimating his chances of self-survival.

A sudden recourse to minor crime by a previously well-behaved man may be one of the premonitory symptoms of impending breakdown.

I shall have something more to say (under Prevention) on the signs to be looked for during training periods.

#### TIME OF OCCURRENCE.

Perhaps too much stress should not be laid on this, but there is evidence to show that cases of neurosis occur amongst the men most frequently at the following periods: (a) height of battle; (b) the hour before going over the top; (c) the evening before return to the trenches.

With the officer it was a more gradual affair and suggests that the officer, with more responsibility, is not so self-centred.

#### STATISTICS AND EXTENT OF NEUROSIS.

The statistical records of neurosis cases during the Great War are very incomplete.

In the Fifth and Second Armies, however, during August, September, and October, 1917, some 5,000 cases were admitted to the Neurological Centre for such cases, i.e. about 1 per cent of the troops engaged. The Commanding Officer of a regular battalion of a Scottish regiment says that "the number of cases of breakdown and nerves was enormous, and in a modern battle there was always a procession of men left behind in dug-outs who said they had been blown up. A large proportion of them did not want to go on. He did not see any cases amongst regulars but plenty in 2nd Line Territorials."

The neurologist at one of the Army centres said that at one time he had most of the officers and men of a certain unit in his hospital. It seemed as if a panic had arisen and they had all gone down together.

These extracts will bring home to you the seriousness of the problem from a military point of view.

## CAUSATION.

In the causation of neurosis we have to consider the changes which take place in the mental processes, and also the factors which help to bring about the changes. There are certain primitive instincts and emotions which are normally under the control of the higher mental activities. Neurosis follows from the loss of control by these higher activities giving free rein to the play of instincts and emotions. It will be obvious to you that, in the cases of neurosis I have described, the emotion which is being given full play—or has been heightened or stepped up—is *fear*. You will have recognized that some of these cases show the bodily accompaniments of fear—the staring, frightened look, pale face and trembling limbs.

On active service a soldier is constantly torn between the instinct of self-preservation and those forces compounded of self-respect, duty, discipline, patriotism, etc., all of which may be summed up as *morale*.

The object of training is to give overwhelming superiority to the morale group, so that the issue of this mental conflict is a foregone conclusion.

If a man is wounded or taken prisoner there is an immediate end of the mental conflict; if he develops a neurosis there is also an end to the conflict, but the self-preservation instinct has triumphed in this case.

The actual symptoms produced by the neurosis case probably arise in differing ways; for example, the man who is hysterically deaf may have been temporarily deafened by the noise of a bursting shell, but the emotion of fear or the instinct of self-preservation causes that deafness to persist when it should have passed away. In other cases the lengthy duration of the mental conflict produces a gradual breakdown with symptoms of exhaustion.

The mental conflict may be between control and fears, not obviously connected with self-preservation, e.g. fear of closed spaces, open spaces, fear of being afraid, fear of not being able to carry a heavy pack on the march, etc. Fear may not be the only emotion—horror, remorse and grief from various causes may be the emotion concerned.

Finally, in some of the cases emotion seemed to play no part, and in many of these there was conscious simulation of disabilities; e.g. one neurologist found that nearly 3 per cent of his first 1,000 cases of neurosis were malingerers—self-confessed at that—having mostly feigned loss of memory.

So far we have considered the mental processes concerned in the production of neuroses. We may sum them up by saying that some form of emotional disturbance existed in the mind. Without this disturbance neurosis does not occur, but it took far more than emotional disturbance acting alone to cause neurosis; other factors played their part.

Physical and mental exhaustion (which result from the thousand and one ills of modern warfare) were often also present in the cases. Stress

and strain, loss of sleep, noise, discomfort, poor food, alcohol, war gases, the poisons of infectious diseases—all these took some part in the causation.

Even so, all soldiers exposed to these ills and disturbance of emotions did not develop neuroses, which only formed about 2 per cent of the medical disabilities of the war. There were still other factors present which may be considered as—

#### PREDISPOSING CAUSES.

Some individuals had a family history of weakness, defect or instability of the nervous system, and thus were inherently predisposed towards the occurrence of neurosis. Others acquired such predisposition from having sustained concussion before the war, or having suffered a mental or nervous breakdown, or from inebriety or drug habits. Such predisposition, whether inherited or acquired, was present in the majority of cases of neurosis and was of great importance in determining a man's reaction to the stress of his environment—gave him the wrong bias or weakened his control.

The predisposition towards the occurrence of a neurosis was not present in all cases—and in others certain contributory factors were of importance in bringing about its occurrence. Such are the following :—

(1) *Responsibility*.—This is well borne by those fitted by nature, education, character and status to be leaders ; in these cases responsibility gives additional stimulus to self-control. Responsibility is not well borne by those elevated to a rank beyond their capacity and acts as a cause of mental unrest, helping to bring about nervous breakdown. *Too prolonged* responsibility helped to cause nervous breakdown, e.g. I well remember a battalion commander who had commanded a territorial unit for over three years in France—literally a nerve-breaking responsibility, as it proved in the end. Married men, with their added responsibilities, are more prone to suffer neuroses.

(2) *Inaction under Fire*.—Man's reaction to danger is normally to *do something* about it, and, if he has to remain inactive, a severe mental conflict is set up with the possibility of a neurosis as a result. It is quite justifiable to give people unnecessary jobs to occupy their attention under such circumstances. Mobile warfare has a tremendous advantage over trench warfare as regards inaction under fire.

(3) *Exhaustion, Fatigue, Sleeplessness*.—Physical exhaustion alone does not do damage, but, combined with nervous exhaustion, plays some part in the causation of neurosis. Sleeplessness is particularly important, since in sleep there is a re-creation of nervous energy.

(4) *War Gases*.—Must be recognized as a contributory factor in the causation of neurosis, both from the dread they cause and the physical effects which they may occasion.

(5) *Alcohol*.—This plays little part in the production of neuroses—except that parental alcoholism leaves the children with damaged nervous systems and liability to neuroses. Heavy drinking was often a sign of incipient neurosis, and no doubt precipitated the ultimate result. The

rum ration given in coffee or tea before going over the top was undoubtedly "doping," but certainly helped countless men to endure the attack. The strictly moderate use of alcohol in the evening accords with normal custom and is useful for its soothing and sedative action, but alcohol, of course, should not be taken in any situation demanding the use of the highest mental faculties.

(6) *Syphilis, and other Venereal Diseases*.—These may have contributed in some cases—through fear, anxiety or shame engendered in the sufferer. The toxins of these diseases probably play the same part as those of other infectious diseases.

(7) *Malaria, Dysentery, Influenza, Trench Fever, etc.*—These diseases probably acted as contributory causes of neurosis, more especially in those cases associated with nervous exhaustion.

We may summarize the causation of war neurosis as follows: In its causation some emotional disturbance occurs, and physical and mental exhaustion are associated with this. Inherited or acquired predisposition to the occurrence of a neurosis is present in the majority of cases, and the contributory factors already discussed assist in the occurrence.

#### PREVENTION.

Before detailing the measures which can be applied for the prevention of neuroses let me quote you the opinions of some distinguish soldiers:—

A former Director-General of the Army Medical Services: "There was little neurosis in the Guards Division—well-trained and disciplined in peace, with *esprit de corps*, loyalty, pride in self and regiment and history of the regiment—all very important."

A neurologist, who had been a Regimental Medical Officer: "Knew of two battalions with differing rates of neurosis, and it was obvious from the slovenly appearance of the men which had the cases."

Another neurologist attributed increases in neurosis to loss of morale among the later trained troops (conscripts) and good morale to cover all prevention.

An Inspector of Infantry Training: "Ability to stand modern war depended almost as much on mental and nervous condition as upon physical condition." This statement is probably even more true to-day.

A distinguished R.A.F. Officer: "Leadership is the most important factor in maintaining morale and reducing neurosis. Prevention by good environment including the habit of cheerfulness, the gift of laughter and a sense of humour."

A distinguished V.C., who has risen to the top of his profession: "Discipline and drill are required. Drill—moving together in unison—creates a feeling that men belong to a mass and keep the corporate spirit. I think officers must be taught much more about man-mastership."

Man-mastership includes a knowledge of the psychology of the soldier and of the physiology of his work.

## PREVENTION DURING THE TRAINING PERIOD.

(a) Inculcating highest possible standard of morale, discipline, *esprit de corps*, esteem of officers and confidence both individual and collective.

(b) Ensuring and maintaining mental, physical and moral fitness and technical efficiency.

Prompt and automatic obedience to orders must be secured. The spirit of individual effort must be created—make the man think and act for himself and be resourceful. Train with one object only, viz., *to fight*.

Use carefully selected instructors, who must not be overworked. Study character as far as it is applicable to military life. Training must be sufficient—ill-trained troops break down. A well-thought-out scheme of training must be followed—the training Manuals see to this.

Train men not to be thrown off their balance by some unusual stress but to be capable of adjusting themselves to sudden changes in dress, orders, duties and movements. Practice performing duties in half or quarter of the usual time; attempt strenuously the impossible, as often happens on active service, but only make these attempts with fully-trained soldiers.

It is *not* advisable to try to reproduce in training the physical conditions of the front line—it is impracticable. Do not give any special training in neurosis—it may cause it.

Instruction should be along the lines that every man feels fear to some extent at some time; it is natural and nothing to be ashamed of. No good soldier allows fear to influence him, and to give way is reprehensible. No properly trained soldier will have difficulty in carrying out his duty under any circumstances.

Training should be elastic; time should be given to train men who learn slowly. They can often be brought up to the same standard as the others, but hurrying them too much sows the seeds of future neurosis.

During all training combatant officers and N.C.O.s should keep watch for abnormalities from which a medical officer may infer mental unsoundness. Close co-operation is required between regimental officers and the medical officer.

To neglect morale in any of its aspects is to invite large and unnecessary casualties in battle.

## MORALE.

You will find it defined in the Training Regulations. It has been aptly said: "Morale is the acquired quality which in highly trained troops counterbalances the instinct of self-preservation. . . . Example is the foundation of morale."

Note two things here: (1) the words "highly trained," and (2) that to prevent neurosis you must counterbalance the instinct of self-preservation.

The *sources of morale* have been defined (by a distinguished Army Commander) as justice of cause, pride in regiment, supremacy in use of weapons, plus good food and good care of the men.

*Abnormalities* from which a medical officer may infer mental or nervous unsoundness include the following :—

- (1) Resentfulness to discipline or inability to be disciplined.
- (2) Unusual stupidity or awkwardness in drills and exercises.
- (3) Inability to transmit orders properly.
- (4) Personal uncleanness.
- (5) Criminal tendencies.
- (6) Abnormal sex practices including masturbation.
- (7) Filthy language and defacement of property.
- (8) Distinct feminine types.
- (9) Bed-wetters.
- (10) Subjects of continual ridicule and teasing.
- (11) Queer or peculiar behaviour.
- (12) Recruits who persistently show the following : Tearfulness, irritability, seclusiveness, sulkiness, depression, shyness, timidity, anti-social attitude, over-boisterousness, suspicion, dullness, sleeplessness, sleep-walking.
- (13) Chronic homesickness.
- (14) Men showing reluctance to accept risks of physical injury in sports and games.
- (15) Stammerers.
- (16) Men showing any *undue* disturbance when learning to ride, firing on the range, first entering a gas chamber.
- (17) Men very nervous in manner, apparently highly-strung and lacking in self-confidence.

Many men can by training and education get rid of their nervous disabilities, and the best way to eliminate the potential neurasthenic is to train him into a good soldier. This process takes place in regiments with little neurosis.

We have dealt with prevention during the training period and now have to turn our attention to prevention on active service. Here I would again impress on you that mobile warfare is infinitely better for the nerves than trench warfare for the reason that one is not so likely to sit down under a "hammering" in the former but *do something about it*.

#### PREVENTION ON ACTIVE SERVICE.

(a) Maintain good morale, high standard of discipline, *esprit de corps*—maintain these on active service as you trained for them beforehand.

(b) Good officers set a good example. They promote confidence and enthusiasm and take an active and personal interest in the welfare and comfort of the men. Their personality counts for much.

(c) *Good regimental medical officers* are necessary and there must be close collaboration between executive and medical officers in the front line.

The Regimental Medical Officer should be endowed with personality ; a good doctor with a sound knowledge of men and imbued with the importance

of maintaining good morale and discipline and of promoting the mental and bodily welfare of all in his charge.

There must be close co-operation of the Commanding Officer with his Regimental Medical Officer. The Regimental Medical Officer need not be a neurologist and, on the other hand, a neurologist will be better able to understand neuroses if he has done his turn with front line troops.

(d) *Short Shifts in the Line.*—If it can be carried out this gives facilities for rest and sleep to avoid exhaustion.

Troops in a dangerous sector should be relieved in turn ; if possible a time limit should be set so that they know how long they are to endure and can brace themselves to meet it.

There is confidence in the company of others on perilous service ; two men should be sent instead of one on dangerous jobs.

Detached and lonely posts should be given more consideration. New troops should be entered gradually into battle and not plunged straight into the thick of war.

(e) *Adequate rest behind the line ; organized recreation behind the line ; leave home ; avoid monotony.*

All these counteract fatigue and exhaustion. Out of the line there should be *some* training, neither too much nor none at all. "Tabloid" sports applicable to large numbers of men and encouraging emulation even amongst the least competent are useful. Concerts, bands, cinema shows, etc., all have their place.

(f) *Interior economy*—great attention should be paid to the comfort of the men—cleanliness, baths, feeding, clothing, cooking and serving of meals.

There is plenty in the measures outlined so far, to keep one's own mind fully occupied, to the exclusion of fears for personal safety.

Before leaving the subject of precautions there is one other thing to say in regard to the possibility of eliminating on recruitment men who might break down later. In the present state of our knowledge I think it must be accepted that such men cannot be picked out at the recruiting medical examination. It is only later, after trial and much observation, that these "martial misfits" can be weeded out.

#### TREATMENT OF NEUROSIS CASES—FORWARD AREAS.

No soldier should be allowed to think that loss of nervous or mental control provides an honourable escape from the battlefield. In the forward areas it is practically not possible to distinguish between neurosis, fear, and malingering, therefore any "mass neurosis" must be very firmly handled. All cases of neurosis should be looked on with suspicion, and being "contagious," no risks should be taken, however unfortunate for the individual.

In the absence of any "mass neurosis," any moderately severe case or man who may have been blown up, can be sent to the Regimental Aid Post, where the Regimental Medical Officer handles him. A rest, sleep, a



meal and "talking to," will probably set him up again, and he goes back to the front line.

More severe or persistent cases should be given a rest at the transport lines or Divisional Rest Station. Every effort must be made to keep these men in the battalion or divisional area. Similarly, men showing the incipient signs of breaking down already mentioned should be given a rest. A great number of men after twenty-four hours' rest are quite fit to return to duty.

Only the most severe cases should be evacuated from the Divisional Area and then to a Special Neurological Centre.

In dealing with neurosis cases it is necessary to recognize the following general types: Fatigue cases; exhaustion and confusional states; hysteria (conversion hysteria); anxiety states; obsessional states.

Treatment, of course, varies with the varying conditions and the facilities available for treatment.

At the Regimental Aid Post the medical officer and his assistants (who probably know the man) handle the case. First a brief rest, then the patient is reassured as to the facts of his disability (i.e. that it is purely temporary, etc.). Strong moral suasion and energetic persuasive methods should be adopted.

Regard every case with the utmost suspicion and be forceful. The majority of cases may be restored to duty at once by these methods. Even the most forceful persuasion will do no harm to those cases which do not respond, compared with the harmful influence of the environment which has caused the disability.

Cases of fatigue, mild exhaustion and confusional states, and early hysterias will respond to the above treatment. If these methods fail or there is no time owing to pressure of work, the cases will have to go on to the field ambulance where they are sorted out and sent to the Neurological Centre.

The anxiety states, the obsessional states, and severer exhaustional and confusional states, and some hysterics will be the cases which have to be evacuated to the Centre.

The Neurological Centre is a place to which the neurosis cases from a wide area, e.g. an Army area, are concentrated. Situated ten to twelve miles behind the line and staffed by specialists in the diagnosis and treatment of these disorders, the centre provides a suitable environment for the cases who receive prompt treatment by appropriate psychotherapeutic measures. There is not time to deal further with the work at the Centres, but here hysterics, some of the exhaustion and confusional states, and milder anxiety conditions will respond in the two to three weeks that the cases are in the Centre.

A residue of cases consisting of obsessional states, severe anxiety states, marked mental disturbances, and intractable hysterics, and possible malingerers will need evacuation to the base for more exhaustive investigation.

Finally, cases of mental deficiency will require to be sent home for invaliding, and mental cases to be sent home for admission to special mental hospitals.

#### RECOVERY FROM NEUROSIS.

As already mentioned, recovery after a short rest is the rule in many cases, *if they are not evacuated*. Even severe cases may recover and become good soldiers again. Let me give you an example quoted by a Vice-Marshall of the R.A.F. :—

“An officer had a bad time in France and developed neurosis. He was sent to the home establishment, had two and a half months' leave, and then home duty. Left to himself pretty well, he gradually got fit and started to fly again—became an instructor. Went back to France and did five months good work before being captured—received M.C. and bar during this period—shot down six enemy planes in one day a few days before his capture.”

I think that answers the question—can a good man recover from neurosis?

Those of you who have read many “war books,” or seen “war plays,” may have gathered the impression that raving lunacy was the ultimate fate of many a conscientious soldier. Well, books and plays dramatize life, but do not necessarily mirror it accurately. Mental confusion and insanity undoubtedly occurred in soldiers—the former a form of neurosis which was usually temporary and from which the sufferer recovered. Insanity was not caused by war, but the seeds ripened in the fertile soil. The men in asylums as a result of the War would undoubtedly have found their way there in the great majority of cases without the aid of the War.

#### MALINGERING, COWARDICE AND FEAR.

Malingering is, of course, “conscious feigning of symptoms of disease.” I have already told you that one neurologist found that nearly 3 per cent of his first 1,000 cases of neurosis were confessed malingerers. It was the opinion of several good observers—both executive and medical—that there was a good deal of skrimshanking amongst the neurosis cases.

In some of these cases it is a most difficult task to decide whether a man is malingering, and they usually require more than one medical examination. It is often necessary to have a man specially observed for some time. You will understand the importance of the decisions involved in courts martial cases.

The following are signs of emotional disturbance which may be accepted as *not* due to simulation: Tachycardia, arrhythmia, diffuse and forcible impulse; sweating, flushing, tache cerebrale; enlargement of the thyroid; *fine* tremor of face and tongue; *fine* tremor of hands; stammer; increased tendon jerks—the supinator and triceps jerk more important than the knee jerk; insomnia and nightmares, polyuria, diarrhoea (if confirmed by observation).

## SUSPICIOUS SIGNS.

Discrepancy of subjective symptoms with conduct.

Variation of symptoms when unaware of observation.

Variation in accord with interests.

Help may be obtained by observing the patient's attitude towards discipline, treatment and recovery, or from evidence as to moral sense in other directions—Conduct Sheet.

As regards cowardice—fear is *not* cowardice—all men may feel fear, and the man who controls that emotion so that it does not influence his actions is courageous. Even the manifestation of the physical signs of fear—trembling, pallor, etc.—does not constitute cowardice, and I have seen many fearful men do gallant actions.

If, however, a man who is capable of exercising his self-control does not do so and does not face the situation, then he is a coward. The difficulty in some cases is to decide whether the individual is capable of *consciously* exercising control, or whether he has a neurosis with accompanying impaired or loss of control. Cowardice is rightly a punishable military crime. As explained, seeming cowardice may be beyond the individual's control. Specialized medical opinion is required in any doubtful case of neurosis. Finally, a man who has proved his courage already should receive special consideration in case of subsequent relapse.

## FINALE.

The characteristics which are essential to success in war are admirably laid down in the various Manuals dealing with training.

Leadership, morale, discipline, fighting spirit, mental education—all these are explained and the methods of securing them pointed out.

In certain countries mass morale is fostered by semi-hypnotic methods which are perhaps appropriate to the peoples concerned, but we prefer the less spectacular, sounder, if more laborious, method of raising the individual's morale, so that in the most desperate situations there will be no mass acceptance of failure, but always individuals whose morale is indestructible and who will lead and fight till they win out.

Read the first chapter in any or all of the following: Educational Training, Training Regulations, Elementary Drill, Physical Training, and remember that the more we can apply the principles laid down in these Manuals to ourselves and our men the less we shall hear of war neurosis in the next war.

## ACKNOWLEDGEMENTS.

The writer wishes to acknowledge the help he has received from the "Report of the War Office Committee on Shellshock." Extracts from the Report have been extensively quoted, both from witnesses' evidence and the Committee's findings, and the lecture as a whole may be considered as a summary of that Report.

The writer is indebted to Major-General F. D. G. Howell, D.S.O., M.C., K.H.S., Deputy Director of Medical Services, Aldershot Command, for permission to send the lecture for publication.

## SOME OBSERVATIONS ON SALMONELLA FLAGELLAR ANTIGENS.

By MAJOR G. T. L. ARCHER,  
*Royal Army Medical Corps.*

THE discoveries in bacterial variation and the identification of "O," "H" specific and "H" group antigens which have been made following the work of Weil and Felix (1917), Andrewes (1922), and others, have led in recent years to the differentiation of a large number of species and variants within the *Salmonella* group of organisms.

The object of the present communication is to suggest that certain named variants (some of which up to 1932 were even classified as distinct species) have no true claim for separate consideration, their apparent differentiation depending upon (1) the existence of dominant and recessive antigens; (2) variation in different strains, or cultures of one strain, of "H" group antigen components.

### I.—DOMINANT AND RECESSIVE ANTIGENS.

When making use of the terms "dominant" and "recessive" in describing the behaviour of bacterial antigens, no suggestion is intended that they are dominant and recessive genes in the Mendelian sense. The words are merely used as expressing the behaviour in cultures of the organisms containing such antigens.

Two *Salmonella* variants, *Bact. typhi-murium* var. *binns* (*Salmonella ærtrycke-binns*) and *Bact. cholerae suis* var. *kunzendorf* (*Salmonella suispestifer* (European)), have obtained recognition largely on the assumption that they are monophasic in the group phase. Of these, the Binns variant has already been shown by Edwards (1936) to be, in fact, diphasic and indistinguishable from *Bact. typhi-murium* in the composition of its flagellar or "H" antigen. On the other hand, Vedel (1936) states that the latter organism never shows specific colonies in its cultures. I propose to show that both these organisms possess the specific antigen of the related species in a recessive state. For the sake of brevity these variants will be referred to hereafter as "Binns" and "Kunzendorf."

The strains used in the experiments to be described were the "Binns" culture maintained at the Royal Army Medical College, a fresh subculture of "Binns" obtained from the Lister Institute, and the Schutler strain of "Kunzendorf" maintained at the Royal Army Medical College. The Schutler strain was originally obtained from the Lister Institute, and produces no change in dulcitate after forty-eight hours and is H<sub>2</sub>S positive.

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Dreyers' technique was used in carrying out the agglutination tests performed in the course of this work.

### EXPERIMENTS WITH *Bact. typhi-murium* VAR. *Binns*. *Preliminary Observations.*

In the course of examining the titres of serums prepared against "Binns" and the specificity of emulsions prepared from *Bact. typhi-murium*, the results shown in Table I were obtained:—

Serums	Suspensions	
	"Binns"	<i>Bact. typhi-murium</i> (specific)*
"Binns" 309	$\frac{1}{10,000}$	$\frac{1}{10,000}$
"Binns" 309/3	$\frac{1}{10,000}$	$\frac{1}{10,000}$ tr.

\* Suspension proved specific by reaction with other group serums.

The strain of "Binns" used was thus capable of producing agglutinins for the specific *typhi-murium* antigen.

Suspensions prepared from this strain, however, showed only group characters when tested by agglutination. These results can be explained by assuming the presence of organisms in the specific phase in the cultures employed in sufficient numbers to produce a marked immunological response on injection, though too scanty to betray their presence by visible agglutination on testing with group specific serum, i.e. by the specific acting as a recessive to the group antigen.

### THE EFFECT OF GROWTH IN THE PRESENCE OF GROUP SERUM.

To test this hypothesis further, I now decided to use the technique described by Scott (1926), viz. cultivation of the organism in broth containing group serum, in an effort to produce specific suspensions of "Binns."

The group antibodies normally present in the serums used are indicated below in brackets after the name of each, the nomenclature of the Kauffman-White Scheme being used (*Salmonella* Sub-committee 1934. *Journal of Hygiene*, **34**, 333).

*Experiment 1.*—Cultures were made in broth containing "Binns" serum (1, 2, 3), *Bact. stanley* serum (1, 2), and "Kunzendorf" serum (1, 3, 4, 5). Untreated broth was used as a control. Subculture to similar media in each case was made daily for five days. After forty-eight hours' incubation of the fifth subcultures the same medium in each case was used for further three daily subcultures. The final cultures thus being the eighth in each variety of group-serum-broth.

In all the cultures except the controls a considerable floccular deposit

always occurred. Subcultures were made from the supernatant fluid. The day after the last subculture was made the supernatant fluid was pipetted off from each tube and centrifuged. One control culture was similarly treated. The deposits were washed in saline, recentrifuged, resuspended in saline and formolized. A second control broth culture was formolized without centrifuging. Agglutination tests carried out on the suspensions so prepared are shown in Table II.

TABLE II.

Suspension	Serum		
	<i>Bact. typhi-murium</i>	"Kunzendorf"	<i>Bact. stanley</i>
"Binns" washed control ..	$\frac{1}{10,000}$ sl. part.	$\frac{1}{5,000}$ tr. incomplete	$\frac{1}{5,000}$
"Binns" grown in presence of <i>Bact. stanley</i> serum	$\frac{1}{10,000}$	0	—
"Binns" grown in presence of "Kunzendorf" serum	$\frac{1}{25,000}$ part.	—	$\frac{1}{250}$ tr.
"Binns" grown in presence of "Binns" serum	Failed to emulsify		
"Binns" formolized broth control	$\frac{1}{500}$ incomplete	—	—
Part. == partial	Used where more or less flocculation occurred but fluid remained somewhat turbid in all significant dilutions.		
Sl. part. == slight partial			
Incomplete			

Note.—The *typhi-murium* serum used had a specific titre of 1 : 10,000 and a group titre of 1 : 500.

A pure specific emulsion (the specific antigen being that of *Bact. typhi-murium*—"i" in the Kauffmann-White nomenclature) was thus prepared from the supernatant portion of a culture of "Binns" in broth containing *Bact. stanley* serum, the group antibodies present in the culture having agglutinated the organisms in the dominant group phase and thrown them down as the floccular deposit referred to above.

It will be seen, however, that the washed control also apparently contained organisms in the specific phase, since slight partial agglutination to the full specific titre occurred on titrating this suspension with *Bact. typhi-murium* serum indicating the presence of a proportion of organisms in the specific phase, owing to the presence of which also the group agglutination by "Kunzendorf" serum was incomplete.

In view of this the experiment was repeated using a fresh subculture of "Binns" obtained from the Lister Institute.

*Experiment 2.*—The actual group titres of samples from the batches of serum broth used in the experiment were tested with the following result :—

Broth containing "Binns"	serum agglutinated "Binns" ..	1 : 250 +
" " "Kunzendorf" "	" " "Kunzendorf" ..	1 : 250
" " <i>Bact. stanley</i> "	" " "Binns" ..	1 : 25 tr.

Broth containing *Bact. bovis-morbificans* group serum (1, 3, 4, 5) was also used.

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*Technique.*—(1) A tube of each variety of group-serum-broth was inoculated with "Binns."

(2) After twenty-four hours a subculture was made from each tube to one containing a similar kind of group-serum-broth. The supernatant part of the twenty-four-hour growth was then pipetted off from each tube and formolized. These "primary suspensions" were tested for the presence of the specific "i" antigen by the use of *Bact. typhi-murium* specific serum.

(3) After twenty-four hours' growth of the first subcultures second subcultures to similar media were made from each of them. The supernatant portions of the first subcultures were pipetted off and formolized, these constituting the "secondary suspensions" which were in turn tested for the presence of the specific "i" antigen.

(4) Twenty-four hours later the supernatant portions of the second subcultures were removed, centrifuged, and the deposits washed and resuspended in saline. The "tertiary suspensions" thus prepared were similarly tested for the presence of the specific antigen.

The suspensions so produced gave the following agglutination reactions.—

The "primary suspension" of organisms grown in the presence of *Bact. stanley* serum was well agglutinated by *Bact. typhi-murium* serum to a titre of 1:20,000. The "primary suspensions" of organisms grown in the presence of *Bact. bovis-morbificans* and "Kunzendorf" serum showed slight partial agglutination by *Bact. typhi-murium* serum to 1:20,000 tr.

Similar reactions were obtained with the "secondary suspensions." Those derived from *Bact. bovis-morbificans* serum-broth and "Kunzendorf" serum-broth were also agglutinated to some extent by *Bact. stanley* serum. (A similar result occurred in the first experiment, *vide* Table II. The type of agglutination, the low titre, and the possession of a common "O" antigen, suggests that these were "O" reactions, the partial nature of the specific response being due in these cases to the suspensions containing a mixture of "H" specific and "O" organisms.)

The "tertiary suspensions" of organisms grown in the presence of *Bact. stanley* serum was also agglutinated to the specific titre of the *Bact. typhi-murium* serum, while that of organisms grown in the presence of "Binns" serum showed auto-agglutination.

This experiment, therefore, confirmed the results obtained by Experiment 1.

### EXPERIMENTS WITH *Bact. cholerae-suis* VAR. *Kunzendorf*.

Since the hypothesis of a dominant group and recessive specific antigen appeared to offer a reasonable explanation of the behaviour of "Binns"

in culture, the possibility at once suggested itself that other organisms hitherto regarded as monoplasmic in the group phase might possess recessive specific antigens.

*Bact. cholerae-suis* var. *kunzendorf* was therefore examined for such antigens.

#### Preliminary Observations.

Two serums prepared by inoculation of rabbits with "Kunzendorf" were tested for the presence of the specific antigen "C" (Kauffmann-White nomenclature) which occurs in *Bact. paratyphosum* C and *Bact. cholerae-suis*. One of these serums with a group titre of 1:5,000 had a specific titre for *Bact. paratyphosum* C of 1:50, the other having a group titre of 1:10,000, failed to agglutinate a specific suspension of *Bact. paratyphosum* C at the lowest dilution put up (1:25).

#### THE EFFECT OF GROWTH IN THE PRESENCE OF GROUP SERUM.

The technique was similar to that described above. None of the primary cultures, or first subcultures, was agglutinated by *Bact. paratyphosum* C specific serum.

The second subcultures were centrifuged, washed in saline, and re-suspended. On testing them against specific serum only granular agglutination to a titre of 1:250 (apparently "O" agglutination) was observed.

The third subcultures were incubated for three days and the supernatant portions tested. The result is shown in Table III.

TABLE III.

Suspension	Serum	
	<i>Bact. paratyphosum</i> C	"Kunzendorf"
<i>B. cholerae-suis</i> v. <i>K.</i> grown in presence of <i>Bact. stanley</i> serum	$\frac{1}{50,000}$ sl. part.	less than 1:500
"Kunzendorf" grown in presence of <i>Bact. bovis morbilicans</i> serum	0	—
"Kunzendorf" grown in presence of "Kunzendorf" serum	Auto-agglutination	
"Kunzendorf" grown in presence of "Binns" serum	$\frac{1}{20,000}$ incomplete	$\frac{1}{500}$ tr.
"Kunzendorf" control broth culture	$\frac{1}{500}$ part.	$\frac{1}{5,000}$ part.

Note.—The *Bact. paratyphosum* C serum used in carrying out all experiments on "Kunzendorf" had the following properties:—

Titre for <i>Bact. paratyphosum</i> C (specific)	..	..	1:10,000
" " " " "O"	..	..	1:125
" " "Kunzendorf"	..	..	1:1,000 tr.
" " "Binns"	..	..	0
" " <i>Bact. stanley</i> (group)	..	..	0

The supernatant portions of the fourth subcultures were centrifuged, washed and resuspended. That from the culture in "Binns" serum-broth showed slight partial agglutination to 1:10,000 with the specific serum.



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### PERSISTENCE OF SPECIFIC CHARACTERS IN THESE CULTURES.

Now that specific antigens had been unmasked in the cultures, I decided to find out, if possible, whether the dominance of the group antigen in this variant, as exhibited by an invariable great preponderance of organisms in the group phase in cultures, would be repeated in each single colony on a plate or not. Plates were therefore inoculated from the fourth subcultures.

Most of the colonies on all plates were rough in appearance but smooth colonies were also observed. Twenty-four colonies were picked off and inoculated to broth. Of these colonies 8 were smooth, 6 slightly rough and 10 rough.

On the following day the broth cultures were formolized and tested for the presence of the specific antigen "C" by the use of *Bact. paratyphosum* C serum.

4 were agglutinated to a titre of 1 : 10,000  
 17 " " " " 1 : 1,000 (i.e. the group titre of the serum)  
 1 was " " " " 1 : 2,000  
 2 were not agglutinated at 1 : 1,000

The first four suspensions thus showed the presence of the specific antigen. They were, accordingly, further examined for the presence of group antigens. The results, with the source of each culture, and the nature of the colonies, are shown in Table IV. It will be observed that whereas suspensions 1 and 2 were mixed, suspensions 3 and 4 showed no evidence of the presence of group antigens.

TABLE IV.

No.	Source of colony	Nature of colony	Serum		
			<i>Bact. para</i> C	"Kunzendorf"	<i>Bact. bovis, moribundans</i>
1	Plate from broth containing "Binns" serum	Smooth	$\frac{1}{10,000}$ part.	$\frac{1}{5,000}$ sl. part.	$\frac{1}{500}$ sl. part.
2	" "	"	$\frac{1}{10,000}$	$\frac{1}{5,000}$ incomplete	$\frac{1}{500}$ part.
3	" "	"	$\frac{1}{10,000}$	less than $\frac{1}{500}$	less than $\frac{1}{50}$
4	Plate from broth containing <i>Bact. stanley</i> serum	"	$\frac{1}{10,000}$	less than $\frac{1}{500}$	less than $\frac{1}{50}$

The "Kunzendorf" serum used had a group titre of 1 : 10,000 and specific titre of less than 1 : 25. 1 : 500 was the lowest titre tested. The *Bact. bovis-moribundans* serum had a group titre of 1 : 5,000 but was only tested between 1 : 50 and 1 : 500.

Thus, pure specific colonies containing specific antigen "C" were obtained by Scott's method, from a culture of *Bact. cholerae-suis* var. *Kunzendorf*.

## DISCUSSION.

The results obtained with these two "monophasic" organisms therefore suggest that they have been so designated owing to the persistent "dominance" of the group antigen which, in all ordinary cultures, masks the presence of organisms in the specific phase.

In specific cultures of diphasic organisms, on the other hand, the presence of organisms in the group phase, masked by the more usual specific dominance, is suggested by the results of animal inoculation, an apparently pure specific culture of such an organism producing almost invariably a serum with a considerable "group" titre. Such a result can also be explained by postulating the presence of small amounts of group antigens in each specific organism, and Dible (1932) gives this interpretation of Andrewes' results. Apart, however, from the necessity of assuming that such group antigens even if present in very small amounts must be masked in some manner in apparently pure specific emulsions to prevent their interaction with, and the consequent agglutination of the organisms by, group serums, the relatively small group antibody content of serums produced by using the supernatant portion of a broth culture containing group serum as the inoculum suggests that the former explanation is the more probable.

I now attempted on similar lines to produce group cultures from two of the organisms described as monophasic in the specific phase, namely, *Bact. typhosum* and *Bact. paratyphosum* A, but met with no success. *Bact. paratyphosum* A was grown in the presence of the homologous serum and, as when "Binns" and "Kunzendorf" were similarly treated, the resulting culture showed auto-agglutination ("rough" variation). *Bact. typhosum* (strain Watson) was grown in *Bact. stanley* serum (which had, however, the obvious disadvantage of a considerable group titre). "O" cultures were produced.

## II.—VARIATION IN THE GROUP ANTIGEN CONSTITUENTS IN DIFFERENT CULTURES OF THE SAME SPECIES.

The anomalous behaviour of certain "group" bacterial suspensions, when titrated with "group" serums, would appear to indicate that the group antigens, considered characteristic of a species, are subject to wide quantitative variation, certain of them being absent, or very greatly reduced, in certain strains or cultures. This contention may be illustrated by a few examples, though I realize that such as follow can only be accepted as circumstantial evidence, and that complete proof must depend upon quantitative absorptions and titrations measuring the amount of agglutinin for each factor. I hope to carry out further work on these lines in due course.

*Example 1.*—A serum prepared against *Bact. paratyphosum* C. (group

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antigens 1, 4, 5) gave the following titres, on testing with group suspensions.

Titre for "Kunzendorf" (1, 3, 4, 5)	..	..	1:1,000
Titre for "Binns" (1, 2, 3)	..	..	0
Titre for <i>Bact. stanley</i> group (1, 2)	..	..	0

The antigen 1 (the only antigen common to all members of the *Salmonella* group which exhibit a group phase so far described) was thus apparently absent, either from the organisms in the group phase present in the immunizing suspension employed (strain Hirschfield), with a resultant absence of the corresponding antibody in the serum, or from the "Binns" and *Bact. stanley* cultures used in the test.

That the para. C group complex was incomplete is the more likely hypothesis in view of the following findings:—

(a) A serum prepared against the same strain of *Bact. stanley* agglutinated a suspension of "Kunzendorf" at a titre of 1:500 tr., a result which must have been dependent upon the presence of antibody 1 in the serum, and hence of antigen 1 in the inoculum used. It may be noted, however, that the homologous group titre of this *Bact. stanley* (1, 2) serum was 1:2,500 (more than five times that for "Kunzendorf") suggesting that the inoculum was richer in antigen 2 than in antigen 1, or that the immunogenic power of 1 is lower.

(b) The "Binns" suspension, as used for testing the para. C serum, was agglutinated by a "Kunzendorf" serum to 1:5 of the homologous titre. The common factors being 1 and 3.

*Example 2.*—A serum prepared against *Bact. bovis-morbificans* (1, 3, 4, 5) gave a negative result when tested upon a suspension of *Bact. stanley* but agglutinated "Binns" at 1:50 and "Kunzendorf" at 1:5,000. In this serum, therefore 4 and 5 antibodies predominate while there is apparently a relatively very small 3 content and an absence again of 1.

*Example 3.*—Three serums prepared against *Bact. paratyphosum* B (group antigens 1, 2) and two serums prepared against "Kunzendorf" gave group titres which are represented in Table V as percentages of the highest observed for each serum.

TABLE V.—PERCENTAGES OF TOTAL GROUP TITRES OBTAINED BY TITRATING SERUMS AGAINST DIFFERENT GROUP ANTIGENS.

Serum	Suspensions		
	"Binns"	<i>Bact. stanley</i> group	"Kunzendorf"
249/3 Para. B .. ..	50.0	100.0	5.0
3/36 Para. B .. ..	100.0	—	100.0
30/36/2 Para. B .. ..	100.0	100.0	40.0
29.37.1 "Kunzendorf" .. ..	20.0	—	100.0
305 .. ..	2.5	—	100.0

This table indicates that different cultures of the same strain may show marked variation in the relative proportions of the antibodies typically present in their group phase.

## SUMMARY AND CONCLUSIONS.

It has been shown that certain specific "H" Salmonella antigens may be "dominant" or "recessive" in culture.

When recessive their presence may be overlooked and organisms bearing them be classified as monophasic in the group phase.

Evidence has also been brought forward which suggests that in certain cultures one or more of the normal antigenic components of the group phase of the organisms present may be absent or greatly deficient.

In view of these findings it is suggested that the recognition of strains apparently monophasic in the group phase is of doubtful validity, that variants so described should be examined on lines similar to those described above, and that classification on minor apparent differences in the group antigen complex (as found in *Bact. Newport* and *Bact. Newport* var. *Kottbus* and in *Bact. anatum* and *Bact. anatum* var. *muenster*) is probably without value.

## ACKNOWLEDGMENTS.

I wish to thank Professor L. J. Davis, of the University of Hong Kong, Major J. S. K. Boyd, R.A.M.C., and W. M. Scott, for their kind assistance in the preparation of this paper.

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## AN ACCOUNT OF SIX SOLID TUMOURS OF THE JAWS.

BY MAJOR S. H. WOODS, O.B.E.,  
*The Army Dental Corps.*

APART from the small fibrous epulis, solid tumours of the jaws are seldom met with in Army practice. The following account of the six cases I have seen in the past ten years at the Queen Alexandra Military Hospital, Millbank, London, may therefore be of interest.

The cases are taken in order of occurrence, and, for convenience, the thirty-two teeth are shown by the following notation :—

87654321		12345678
87654321		12345678

1 indicates central incisor.	4, 5 indicate first and second premolars.
2 indicates lateral incisor.	6, 7, 8 indicate first, second and third
3 indicates canine.	molars respectively.

Thus : 4| signifies upper right first premolar.

|8 signifies lower left third molar.

*Case 1.*—March 15, 1927. Variety : Giant-celled epulis.

In-pensioner C., Royal Hospital, Chelsea, aged 62. He reported for the extraction of a loose, tender |6, which was found to be embraced by the buccal and palatine extensions of the sessile tumour shown in fig. 1.

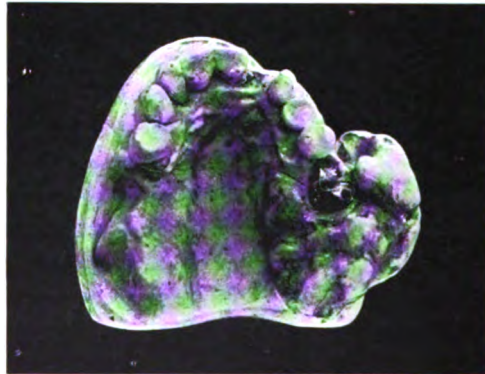


FIG. 1.—Giant-celled epulis.

*Description of Tumour.*—It arose by a broad base from the periosteum of the left tuberosity which it overlapped. It was lobulated, of spongy consistency, and reddish-purple in colour. It filled the buccal sulcus, slightly displacing the cheek ; its surface was not ulcerated ; it did not

bleed or cause pain on compression, but bled somewhat freely when scratched. The rest of the maxilla was healthy; the cheek in contact was normal in appearance and mobility; no enlarged glands could be felt in the face or neck.

| 6 was thickly covered with salivary calculus and there was marked sepsis around it.

| 78 were missing, and also the opposing | 678.

*Previous History.*—Patient said he first noticed a small mass behind | 6 about five months ago. He had felt it enlarging, but, as it caused no pain or discomfort, he did not report for treatment. | 6 had become progressively loose and tender.

*Treatment.*—Under local anæsthetic, | 6 was extracted, the growth with its base dissected off and the exposed area of bone scraped. Healing by granulation was normal.

*Microscopical Report.*—"The specimen consists of fibrous tissue and septa enclosing masses of giant cells, and is covered with many layers of stratified epithelium. It is classified as a giant-celled epulis."

*Result.*—When this old warrior died at Millbank two years later from heart disease, there was no sign of recurrence.

*Remarks.*—(a) The probable cause was the chronic gingival sepsis round the non-functional | 6. (b) It was benign, though the age of the patient and the situation of the tumour were highly suspicious. (c) Rapid growth, marked vascularity, lobulation and purplish colour are characteristic of this type of epulis. (d) The pressure of the cheek on one side and of the tongue on the other, would tend to cause enlargement in a forward direction. (e) Owing to the absence of the lower opposing teeth, there was no traumatic occlusion on the mass, hence it was not ulcerated. (f) There was no recurrence after radical treatment by excision.

*Case 2.*—March 26, 1929. Variety: Fibrous epulis.

Sgt. B., R.A.M.C., aged 31, twelve years' service. At the annual dental inspection he presented the tumour shown in fig. 2, extending from | 1 to | 4 and almost covering | 23, only the tips of which were visible.

*Description of Tumour.*—It was hard, rounded, slightly movable, free along the top and sides but bound down along its lower border by a short, thick pedicle arising from the gum margin between | 34, with secondary adhesions between | 123; gum pink in colour, painless and did not bleed on compression. It displaced the lip and was unsightly. The sharp edge of a buried root of | 4 could be felt.

*Previous History.*—Patient said he first noticed a small movable mass of gum between | 34, in 1925. Increase in size was slow but had accelerated in the last year. It had not bled or caused pain, and, as he was then serving in India at a station distant from a dental centre, he had not reported for inspection.



*Treatment.*—Under local anæsthetic, the tumour was removed, its pedicle and secondary connexions were traced to their source and excised, [4] root was extracted and the gingival sepsis treated.

*Size of Tumour.*— $1\frac{1}{4}$  inches long,  $\frac{3}{4}$  inch wide,  $\frac{1}{2}$  inch thick.

*Microscopical Report.*—"A typical fibrous epulis, consisting of connective tissue with scattered masses of inflammatory cells, covered with many layers of gum epithelium."

*Result.*—There was no sign of recurrence on inspection four years later.

*Cause.*—Chronic irritation of the sharp edge of [4] root, combined with gingival sepsis.

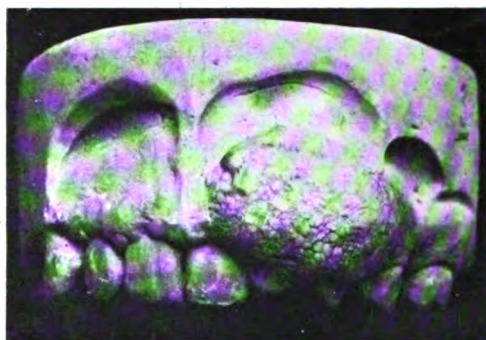


FIG. 2.—Fibrous epulis.

*Remarks.*—(a) The fibrous epulis is inflammatory in origin and arises by a pedicle at the site of irritation. (b) Growth is slow, and the colour resembles that of the surrounding gum. (c) As the soldier is now dentally inspected at least once a year, these growths are usually discovered in the early stage when about the size of a pea. Occasionally, a soldier's wife presents one in a more advanced stage. (d) Treatment must be radical—it is not sufficient to cut through the pedicle, as recurrence is then likely.

*Case 3.*—May 20, 1931. Variety: Adamantinoma.

Pte. L., South Wales Borderers, aged 28; ten years' service. He reported for extensive swelling of left cheek and lower jaw.

*Condition on Admission.*—Discharging sinuses between [2345], which were loose; the body of the jaw under these teeth was expanded, especially downwards; the outer alveolar plate gave easily to pressure.

*Previous History.*—Patient said he first noticed a thickening of the jaw under [45], about three years ago. It was painless, increased slowly, caused no discomfort and so was not reported.

On May 11, while on leave, he was playing football and received a slight blow on the left side of the lower jaw from a player's head while they were both heading the ball. He felt the bone give and some swelling

resulted. He used hot mouth-washes and was fairly comfortable till the 19th, when the condition "flared up" and forced him to report on account of acute infection and swelling.

*X-ray Appearance.*—Fig. 3 is a lateral view of the left side, revealing that the slight blow had dented the much-thinned outer plate, causing a fracture along the line shown, resulting in acute infection of the tumour within, hence the "flare-up."

The bony expansion, especially downwards, is well shown, as is the typical appearance of soft tumours within the mandible.

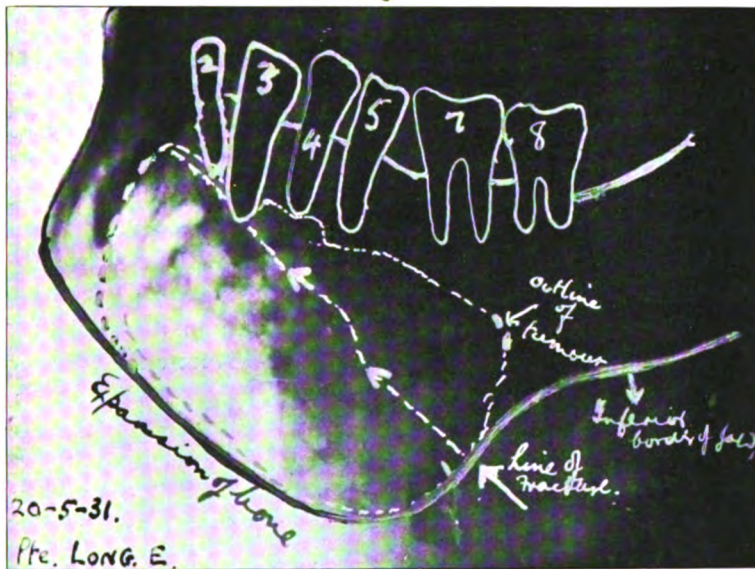


FIG. 3.—Lateral X-ray of adamantinoma (retouched).

*Treatment.*—May 20: | 12345 were extracted under nitrous oxide. Daily irrigation with eusol till swelling and discharge had ceased. June 19: Operation by surgical specialist—exposure and removal of outer alveolar plate and extensive curetting of the soft, vascular, maroon-coloured tumour.

*Microscopical Report on Scrapings.*—"The growth is classified as an adamantinoma. These growths are solid or cystic arising within the alveolar borders, distending and excavating them. The course is slow and, in the early stages, complete extirpation is possible, but the growth should be regarded as of a low grade of malignancy."

Investigation of the long bones revealed no abnormality; the blood-calcium was normal; Wassermann test was negative.

July 16: Wound closed; no glands palpable in the neck. Patient transferred to Middlesex Hospital for deep X-ray therapy.



September 22: Patient returned from Middlesex Hospital. Jaw comfortable, no local reaction; X-ray shows no apparent change except loss of tissue due to removal by operation. On normal diet, 78 functional and comfortable.

October 10: Patient returned to duty.

*Subsequent History.*—I tried to follow up this case, but he passed to the Reserve shortly afterwards, so the subsequent history is not known.

*Remarks.*—(a) This type of tumour is believed to arise from embryologic epithelial remains of the enamel organ—hence its name. (b) It is characterized by the presence of thick strands of epithelial cells pervading its substance, and is sometimes classified as an epithelial odontome. When it consists of masses of epithelial-lined spaces surrounded by dense fibrous tissue, it is known as a fibrocystic odontome. (c) It occurs mainly in the mandible, in the molar and premolar region; it is unilateral; appears chiefly in young adults; is about twice as frequent in the female. (d) The cause is obscure—trauma and chronic infection are said to be connected with its development. (e) If left untreated, it may assume a large size, causing marked deformity of the face. (f) Metastases do not occur. (g) When discovered very early, extirpation may be successful, but experience tends to show that recurrence is common after scraping, and complete excision of the involved portion of bone is now recommended.

*Case 4.*—December 13, 1931. Variety: Carcinoma.

Quartermaster-Serjeant F., Royal Engineers, aged 39; 20 years' service.

*Condition on Admission.*—He presented a deep ulcer with hard, raised edges excavating the 8 region and vertical ramus. There was no expansion of the jaw; 67 were present, functional and comfortable; and the movements of the jaw were not limited. No glands in the neck could be palpated.

*Previous History.*—Three years ago, while serving in Madras, India, 8 was extracted by a civilian dental surgeon on account of chronic discomfort. The socket did not heal and the local discomfort persisted.

April: Boils on the neck occurred and there was numbness of the left side of the jaw and cheek; the ulcer was sore but not painful.

Transferred home in October, sections were taken from the ulcer and the left submaxillary gland, which was dissected.

Microscopical report was inconclusive as regards malignancy.

X-ray of chest and long bones revealed no abnormality; Wassermann test was negative.

*Millbank.*—As the ulcer was spreading, patient was transferred to Millbank and further sections taken.

*Microscopical Report*, dated December 11. — “Rapidly-growing squamous carcinoma.”

*X-ray Appearance.*—Figs. 4 and 5 show the bone destruction at the left angle.

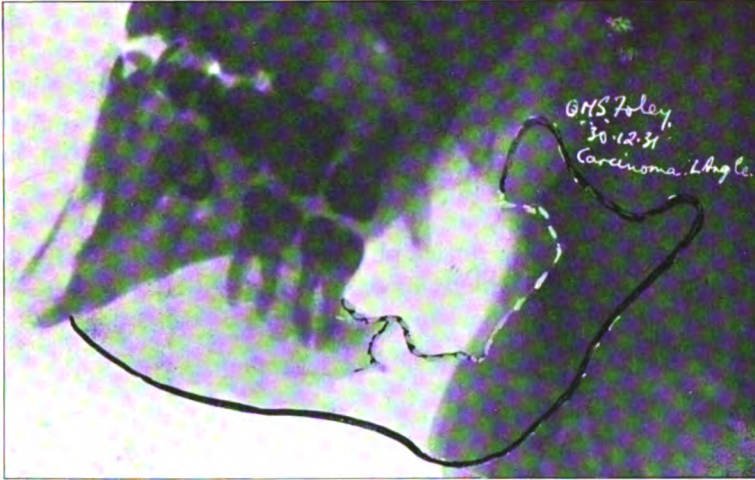


FIG. 4.—Lateral X-ray of carcinoma. Left angle.

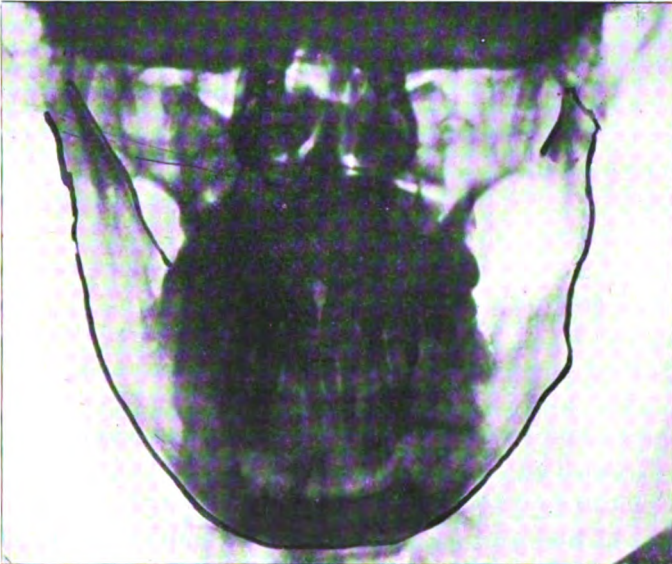


FIG. 5.—Anterior X-ray of carcinoma. Left angle.

*Treatment.*—Transferred to Middlesex Hospital on January 8, 1932.

*Operation:* Excision of jaw from left articulation to  $\overline{5}$  region. The growth was found to be extending into the pterygo-maxillary fossa, and

radium was inserted into this. Very severe pain followed and an attempt was made to inject the left inferior dental nerve with alcohol.

A sinus from the mouth through the left cheek supervened.

Splints capping upper and lower teeth were applied, with elastic traction to counteract the displacement to the left.

Returned to Millbank on April 1, 1932. Next day there was very severe hæmorrhage, overcome by persistent plugging.

April 9: Hæmorrhage recurred and I removed the splints to assist control of the bleeding.

May 2: Patient went on sick leave.

July 15: Re-examined: no pain, no sign of recurrence, masticatory movements limited, but able to manage minced diet. It was arranged that this warrant officer be employed in charge of stores. Subsequently the condition recurred and the patient received further radium treatment, the last application being in October, 1934. He attends the Middlesex Hospital for periodic irradiation with the one gramme unit and, when I saw him in March, 1937, it was reported there was no sign of recurrence. The opening through the cheek is now circular and about the size of a two shilling piece—this is covered by a small piece of lint or jaconet. He manages a fairly hard diet, his general condition is good, and he is re-employed in charge of stores after being invalided from the Service in January, 1935.

*Case 5.*—December 22, 1932. Variety: Myeloma.

Pensioner B., late Green Howards, aged 32; twelve years' service. By arrangement with the Ministry of Pensions this case was admitted for investigation.

*Previous History.*—Prior to August, 1927, the mandible had apparently been normal in all respects—no thickening of bone had been noticed and there was no history of trauma.

On August 7, at Jamaica, the right angle was kicked during a regimental Rugby match—local swelling resulted and a fracture was suspected. No X-ray was taken—four-tailed bandage was applied and there was apparent recovery. The regiment was transferred to Egypt, where, on October 25, the man was admitted for large fusiform swelling of this jaw on the right side. Fracture was suspected though there was no displacement of the bite—X-ray revealed no fracture but much deepening and thickening of the ramus.

With rest and massage the swelling subsided and he was discharged on December 3 to duty.

On December 27, he was readmitted with recurrence of swelling, now larger—seen by surgical specialist, who advised operation.

January 12, 1928: Operation: the outer plate exposed and removed:

extensive scraping of the soft maroon-coloured tumour; condition reported as of chronic inflammatory type.

April 12 : Discharged hospital.

Unit then came home and this man left the Service on January 9, 1929, on the expiration of twelve years' engagement, and was not seen again until December 27, 1932, when his condition was as follows :—

Obvious, extensive expansion in all directions of whole right vertical ramus, angle and horizontal ramus as far forward as 4. All the lower right teeth were present and apparently healthy and the mucous membrane covering the tumour was normal. He complained of headaches, pain when masticating, appetite was good but only soft food could be

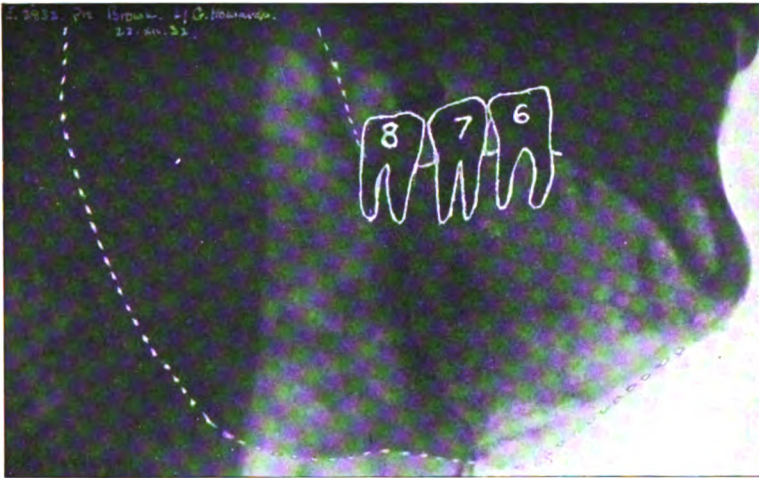


FIG. 6.—Lateral X-ray of myeloma, showing extensive expansion of angle and ramus.

**taken**; attacks of dizziness, especially when at a height, and so could only manage groundwork.

*X-ray Appearance.*—Fig. 6 is a lateral view showing the involvement and expansion of the bone, which is now double in size, in all directions. The bone is delicate and liable to fracture when under normal strain. Investigation of the long bones showed no abnormality; no glands in the neck could be palpated and the blood-calcium was normal.

He was given a disability pension and was inspected at intervals but, as the condition became progressively worse, he was readmitted to Millbank for operation on May 8, 1933, when the bone was again exposed and extensively scraped.

*Microscopical Report on Scrapings.*—"The histological characters are typically those of a myeloma prone to recurrence. There is at present no indication of infiltration of the underlying bone."

As the condition did not improve, the case was admitted to the Cancer Hospital, Fulham, under the care of Mr. Cecil Rowntree, F.R.C.S., Senior Surgeon, to whom I am indebted for notes on the treatment there.

After a course of deep X-ray therapy, the jaw was excised from right articulation to 3̄ on September 22, 1933, after a cap splint with a flange has been fitted, designed to overcome the subsequent displacement.

*Microscopical Report on Biopsy* (Pathological Department, Cancer Hospital).—"Superficially a layer of what appears to be greatly thickened subperiosteal tissue overlies a meshwork of slender, irregularly branching bony trabeculae interspersed with loose connective tissue. The trabeculae are largely composed of osteoid tissue which is undergoing calcification, and most of the trabeculae, especially the smaller ones, show evidence of the apposition of osteoid tissue to their borders. Deep to this rim is a mass of interlacing strands of extremely loose cellular connective tissue, the nuclei of which stain feebly, the bulk of the tissue being made up of poorly-staining collagen fibrils. Scattered capillary blood-vessels are present throughout. At one edge there is a large formation of osteoid tissue derived directly from the connective tissue matrix. The appearances of the tissue are strongly in favour of a non-malignant neoplastic process which has resulted in expansion of the bone while at the same time the fibrous tissue replacing the rarefied osseous tissue tends to undergo ossification."

*Result.*—In October, 1937, the patient's condition was as follows:—

There is falling in and contraction of the right cheek. There is no sinus, patient is comfortable, but requires a minced diet as there is a 50 per cent limitation of masticatory movements and power. His general condition is good, and he has been continuously in employment since 1934. On recent inspection at the Cancer Hospital there was no sign of recurrence and the operation is to be regarded as completely successful.

*Remarks.*—Excepting (a) and (b) the remarks made on Case 3 (adamantinoma) apply equally to this type of tumour.

*Case 6.*—September 4, 1935. Variety, *nævo-carcinoma*.

Gunner B., R.H.A., aged 26; 5 years' service.

*Condition on Admission.*—There was a large ulcerating tumour of the anterior part of the hard palate extending from 5̄ to ̄5, shown in fig. 7, spreading over the alveolar margins between these teeth.

*Description of Tumour.*—It was soft, spongy, red and deeply ulcerated where the lower incisor teeth were biting into it.

A gland could be felt in the right upper deep cervical region.

*Previous History.*—Since 1931, he had worn a well-fitting partial upper denture which was comfortable till February, 1935, when a small mass, about the size of a flat button, was felt on the palate. This increased in size, the denture could not be worn, and the man reported at Khanspur, India.



June 16 : Growth increasing rapidly—now size of a walnut.

Sectioned : Report—papilloma, with very early malignant changes.

Gland palpable in right triangle of neck. Recommended transfer to United Kingdom.



FIG. 7 —Nævo-carcinoma of palate (September 4, 1935).

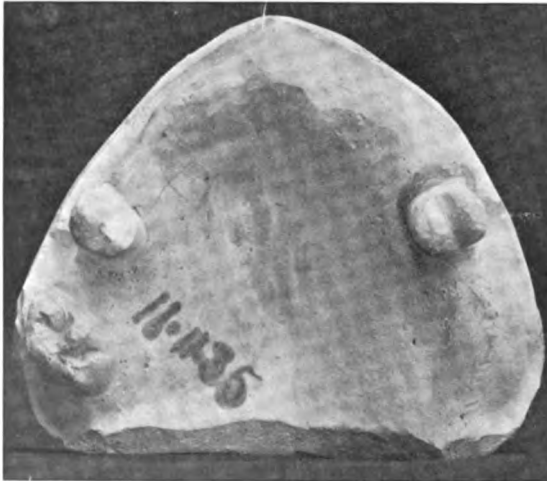


FIG. 8.—After radium therapy (November 11, 1935).

July 17 : Left India.

August 9 : Arrived Netley—growth extending in all directions and ulcerating.

September 4 : Arrived Millbank. X-ray shows no roots under tumour.

Extensive calculus deposits on the teeth were removed and patient was transferred to the Middlesex Hospital, under the care of Mr. W. Sampson Handley, M.S., F.R.C.S., Surgeon-in-charge, Cancer Department, to whom I am indebted for the following notes: (a) *irradiation* of maxilla and triangles of neck with the 1 gramme radium unit four hours daily for a total of ninety hours, followed (b) in two days by *surface application* of radium to primary growth by means of a dental appliance six hours daily for a total of sixty hours, followed by (c) *irradiation* with unit for another fifty hours.

*Result.*—On November 11, the tumour had entirely shrunk, the mucous membrane of the palate being now level; glands are no longer palpable.

Fig. 8 shows the very marked improvement.

*Subsequent Treatment at Millbank.*—I extracted 5 | 5 in February, 1936, as they were loose, but 7 | was retained, as it occluded with a lower molar, thus preventing impingement of lower incisors on the palate.

The patient attended Middlesex Hospital for periodic examination and on July 15, 1936, I fitted him with a partial upper denture. It had not been advisable for a denture to be worn before this date.

When last inspected in December, 1936, on the expiration of his Army service, there was no sign of recurrence, no glands could be felt, the denture was well tolerated, and there was every indication of a complete cure.

I have to thank Colonel P. S. Tomlinson, D.S.O., Officer Commanding, Queen Alexandra Military Hospital, Millbank, for kind permission to send these cases for publication; and I am indebted to Major-General H. M. J. Perry, C.B., O.B.E., K.H.S., Director of Pathology, R.A.M. College, for the microscopical reports; and also to Major-General W. B. Purdon, D.S.O., O.B.E., M.C., a late Professor of Hygiene, R.A.M. College, for the use of his photographic department for the illustrations.

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## THE TRANSJORDAN FRONTIER FORCE.

By MAJOR J. T. ROBINSON,  
*Royal Army Medical Corps.*

### INTRODUCTION.

To my knowledge no Senior Medical Officer has yet written of his experience and duties during the period of his secondment with the Transjordan Frontier Force.

Though realizing that others may be more qualified to describe life with this Arab Force there must be some readers interested to learn something of the personnel and medical organisation therein, and also about the Arab himself.

It is with these sentiments and because my appointment will eventually be filled by a medical officer from one of the Services that I take courage for the task I have set myself, so that those who follow in my footsteps may have some knowledge of what lies before them.

### BRIEF HISTORY.

The Transjordan Frontier Force was formed from the Palestine Gendarmerie on April 1, 1926.

The Force thus raised was intended for military service in Palestine and Transjordan, but was not to be employed outside the limits of the Mandated Territory except with the special permission of the High Commissioner, who might authorize its employment in any adjacent territory when such employment was deemed necessary for the defence of Palestine and Transjordan.

His Highness The Amir Abdullah, the Ruler of Transjordan, is the Honorary Colonel, his eldest son The Amir Talal an Honorary Major, and the younger son The Amir Naif an Honorary Lieutenant.

### GENERAL.

The Force Headquarters is at Zerka, some fifteen miles north-east of Amman, the capital of Transjordan. Stationed at Headquarters are one squadron cavalry and one squadron mechanized, Depot, Quartermaster's stores, M.T. workshops, wireless school, pay department and hospital. At Ma'an, the present terminus of the Hedjaz railway, is the second mechanized squadron, while in Palestine two squadrons of cavalry are stationed in the Jordan Valley.

The Force is commanded by a British officer assisted by one British officer at the head of each department, and three in each squadron. There are twenty-four British officers, the majority of whom are seconded from their units for varying periods. All must learn colloquial Arabic in the first few years of service. Each troop is commanded by a local officer.



In the Force are Palestinians, Transjordanians, Assyrians, Armenians, Chichanes, Circassians, Druze, Egyptians, Germans, Greeks, Hedjazies, Hungarians, Indians, Iraqies, Kurds, Persians, Poles, Roumanians, Russians, Sudanese, Syrians, Lebanese, Turks and Yemenites. These heterogenous nationalities and races in the Force must nearly approach that of the French Foreign Legion. The diversity of creeds is obvious, but the Moslem religion is predominant. Notwithstanding this cosmopolitan symposium, it is an Arab Force, there being 68 per cent Moslem Arabs with arabic the common language and Friday observed as the official weekly holiday.

#### CLIMATE.

The climate of Transjordan varies considerably: Zerka and Ma'an, situated some 3,000 to 4,000 feet above sea-level, have a hot but dry summer and a bitterly cold winter. Snow is not unusual in the winter months.

Stations in the Jordan Valley, two of which are situated about 700 feet below sea-level, experience a hot and sticky summer, but a mild and pleasant winter.

#### MEDICAL ADMINISTRATION AND ORGANIZATION.

The Senior Medical Officer is appointed to the Transjordan Frontier Force by the Colonial Office. He may be selected from medical officers serving in either the R.A.M.C. or R.A.F. and contracts to serve with the Force for a period of four years.

He is solely responsible for all matters concerning prevention of disease, sanitation, training of medical personnel in hospital duties, first-aid, and in duties connected with the evacuation of sick and wounded in the field.

He prepares his own budget annually and for this purpose has allocated to his department a sum of about £1,500. A detailed statement of how this sum is to be expended is submitted to the Commanding Officer for inclusion in the annual budget for the Force. It is then presented to the Palestine Government Estimates Board held in Jerusalem prior to submission to the Secretary of State for the Colonies for his final approval. With this sum a sufficient reserve stock of drugs and dressings is maintained to supply all stations for one year, special allotments being made for anti-malaria measures, instruments, laundry and medical comforts, sufficient reserve funds being held for local purchases of drugs and dressings in cases of emergency.

In circumstances involving special expenditure or the launching of new schemes affecting Government finance, the S.M.O. has direct access to the Director, Medical Services, Palestine Government, whose help and advice can always be obtained. He is also expected to carry out all surgical operations and to advise his local medical officers in the diagnosis and treatment of difficult medical cases.

Over 50 per cent of the personnel of the Force are married and treatment is extended to all families. He, therefore, has on occasions to deal with complicated labour cases.

He resides in the mess at Zerka, there being no accommodation for married officers on joining.



**View of Hospital Compound, Zerka.**



**MEDICAL STAFF EMPLOYED AT ZERKA.**

*Standing :* Trooper A. Mahmud ; Trooper Ayed Jirius ; Trooper Hans Ehrmann ; Trooper A. H. A. Jawad ; Trooper Khalil Ayed.

*Sitting :* Corporal A. A. Ghalib ; Serjeant F. Kaid ; F. Musallam, M.O. ; Major J. T. Robinson, S.M.O. ; British Warrant Officer F. Brailsford ; Corporal A. Angel Yousef.

At Zerka is the main hospital with a normal bed strength of nineteen, which can be expanded to thirty. Here also are the medical stores in charge of a British warrant officer who is responsible to the S.M.O. for all matters concerned with the accounting and issue of supplies therefrom. Here the annual reserve stock for all stations is maintained.

The S.M.O. is assisted by three local medical officers trained and qualified in the American University of Beirut. They are appointed to the Force by the Director, Medical Services, in consultation with the S.M.O. They carry out duties similar to those of regimental M.O.s in the British Army or Air Force and are loyal and efficient officers. One is stationed at Zerka, another at Ma'an, and the third in the Jordan Valley.

In both the latter areas are small reception stations. Medical personnel "other ranks" for all stations are: Serjeant, 1; Corporals, 5; Troopers, 11. All are Arabs but an endeavour is made to keep the ratio of Moslem to Christian equal. They are trained at Zerka in nursing, ward duties and theatre duties, and must obtain the St. John Ambulance badge for First Aid within their first year of enlistment. Many possess the voucher and medallion. An annual course for these awards is given, followed by an examination by doctors appointed by the Director, Medical Services, Palestine Government.

#### THE ARAB.

The generosity of the Arab is well known. A visitor to his house or tent is heartily welcomed and everything put at the disposal of the guest. It is no unusual thing for a poor "Bedouin" to kill his last sheep for an unexpected visitor whom he has never seen and does not know. As a result he may have to live half-starved for days. It would be a gross insult to offer any recompense for such self-sacrifice.

A well-cooked Arab meal may at first appear somewhat revolting but it is an excellent repast. Large salvers are brought into the room or tent piled high with rice and surmounted by a sheep. The guests sitting on the floor encircle the dish and eat with their hands. The host waits on his guests but does not partake of any food until all have finished.

In Transjordan as elsewhere the Arab is a fatalist believing all misfortune, disappointment and disease to be decreed by "Allah." If his child becomes ill and likely to die no attempt is made to save it since "Allah" has ordained it so, and on him the issue depends. On joining the Force he soon realizes that death is not always a necessary outcome of illness and that others can do much to save life.

The natives can be conveniently grouped into the "Fellahen" and "Bedouin." The former are cultivators living in villages, each possessing his own patch of ground. The men are cheerful and good natured but incurably lazy. They spend as much time as possible sipping coffee and

listening to the village gossip. They can seldom read or write their own language, and do the minimum work necessary to keep their families and themselves in food and clothing. They seldom attempt to improve their land, working only during the ploughing and reaping seasons when they may be seen daily in the fields. The harvest gathered or crops sown they drift back once again to leisurely idleness. They, however, make good soldiers, being naturally accustomed from childhood to use a rifle and ride a horse.

The Bedouins are a nomadic people wandering from place to place throughout the year. They look with scorn upon the tillers of the soil and derive their livelihood by breeding goats, sheep and camels for sale or barter. Consequently their wanderings take them wherever grazing is to be obtained. Few of them make good soldiers and, therefore, are not enlisted in the Force in great numbers.



Infant Welfare Centre, Zerka.

#### PREVALENT DISEASES.

Treatment is not confined to the personnel and families of the Force but has been extended to the native civilian population. Many of the latter come three to four days' journey on foot or camel to be examined. As a result cases are interesting and varied—the most prevalent diseases, as in most countries in the Near East, being malaria, trachoma, dysentery, phlebotomus fever and dermal leishmaniasis. All other general maladies are met with.

#### INFANT WELFARE.

For some years a small Infant Welfare Centre was held once a week at Zerka in the schoolroom for the families of the Force. Here sewing-

classes were held and babies weighed. Later, work was enlarged and extended to families of the civilian population, and in 1936 a disused building in an isolated compound in the Camp was turned into a Child Welfare Centre and Clinic.

The clinic is opened daily and mothers are given instruction in ante-natal care, clothing and feeding of infants, while sick children and women are treated.

A fully qualified nurse and midwife is in charge who attends all confinements. She is a Christian Arab from Syria, and a graduate of the American University of Beirut.

#### SPORT.

Polo is played on the local Arab ponies two days a week for the greater part of the year. All who are keen horseman can soon learn to play, as first-class instruction is available in the Force. The standard is not high but is improving each year. The main tournament is played at Samakh in October, when there are usually six to nine teams competing. The open Polo Cup played in Palestine is usually won by a Frontier Force team. The Arab has a "good eye" for the ball but is wild and excitable. He gallops madly about the field, with a loose rein and his horse out of control, chasing the ball and seldom thinking about the rules.

The best sport with a shot gun is found on Lake Huleh, when a week-end party may collect from 150 to 250 head of duck, teal and snipe. Partridge is found in the hills, but to produce a good bag hard walking over difficult country is necessary. Sand grouse vary from year to year. In one year 400 was considered a small bag for a party with six guns. There are no big game, but gazelle and oryx can be found in the Jebel Tubeik. Wild dove in the migration season provide excellent sport.

With the exception of the Gulf of Akaba there is no fishing. Here, however, good sport can be obtained after king fish, tunney and baracouta. The former need skilful angling, and anything up to 70 pounds may be caught.

At Zerka there is a first-class swimming pool, and amenities are provided for tennis, squash, football, and cricket.

#### CONCLUSION.

From this brief and superficial survey I have endeavoured to convey something of the varied and interesting life to be enjoyed in this Arab Force amongst a most hospitable and lovable people. All who have had the opportunity to serve in Transjordan will agree that it was a life full of action, packed with enduring happiness and experience.

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## Editorial.

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### YELLOW FEVER.

At a meeting of the Permanent Committee of the Yellow Fever Commission of the League of Nations held in May, 1938, Colonel S. P. James reported on the cases of yellow fever notified to the office during the six months expiring on March 31, 1938.

He said there has been little or no recent change in the distribution of cases and deaths notified ; but the total incidence is rather less than in the preceding six months. Fewer cases have been reported from the towns, but more have been discovered in rural areas. Most of the cases reported from the large towns were considered to have been imported and the propagation of the disease was arrested by bringing the larval index rapidly to zero.

Though no new important discovery as regards the epidemiology of yellow fever has been made during the past six months, further confirmation has been obtained of the value of the mouse protection test in establishing the distribution of the endemicity of the disease. At a meeting held in London in March Dr. Sawyer, Director of the International Division of Hygiene of the Rockefeller Foundation, stated that in his view there could be no doubt that the positive results obtained are due to the yellow fever virus. The fact that certain persons had a natural immunity did not detract from the value of the test.

The test has revealed that there are only two endemic areas of yellow fever in the world, but both these are very widely distributed. In South America the endemic area extends from Colombia to Paraguay. It is bounded on the west by the Andes. In Africa the zone extends from the littoral of the Atlantic to the Upper Nile and the frontiers of Uganda. Sawyer considers the surprising fact that the endemicity of yellow fever does not extend beyond these two regions to other parts of Africa and South America is due to fundamental conditions at present unknown. Researches are now being carried out in a laboratory at Entebbe installed by the Rockefeller Foundation with the aid of the Government of Uganda. Attempts are being made when studying the fevers of unknown origin to isolate the virus by inoculating mice with the blood of the sick taken during the first three days of the fever.

Colonel James states that the vaccine now employed almost everywhere is an attenuated living neurotropic virus cultivated on tissue. It is inoculated alone without immune serum, except the small quantity of

homologous serum (0.25 to 0.5 c.c.) in which the virus is held in suspension. At the meeting held in London in January, 1937, Dr. Sawyer announced that 80,000 persons in Brazil had been inoculated with attenuated virus grown on tissue, and that no complications had been observed. At the same meeting Dr. Findlay stated that during the past five and a half years 4,300 Europeans had been vaccinated before proceeding to countries where yellow fever is endemic; none of these persons had contracted yellow fever. During the same period 30 Europeans living in English colonies of West Africa had contracted the disease, and none of them had been vaccinated.

Among the 4,300 persons mentioned by Dr. Findlay 2.9 per cent developed jaundice. Most observers consider that the cause of the jaundice is in the serum inoculated with the virus, and is not related to the virus itself. In November, 1937, Findlay made use of a new strain of the virus grown on tissue and up to the present 1,100 persons have been vaccinated with this strain and not a single case of jaundice has been observed. Findlay considers that if this complication is not further reported it is possible that in the blood of the donor, who appeared healthy and whose serum had been previously employed, there might have been a filtrable organism producing the jaundice and this hypothetical virus had been cultivated in association with the virus of yellow fever. This opinion has been supported by the report of Dr. Sawyer on the observations of Soper and Smith at Brazil, where no jaundice appeared after the employment of a particular lot of serum, and by observations on the appearance of jaundice among children after the injection of serum derived from a case of measles.

Additional information about yellow fever in Brazil has been furnished by Dr. J. H. Bauer of the yellow fever laboratory of the Rockefeller Foundation, New York. He states that last winter there was a severe outbreak of jungle yellow fever in Brazil. Although extensive researches have been made it has not been possible to obtain reliable information concerning the living beings in the jungle responsible for the maintenance and propagation of infection in the forests. Also the transmission of infection to man, apart from its unknown origin in the jungle, still remains mysterious. Bauer agrees that yellow fever in the jungle can appear in a marked epidemic form. The duration of infection seems to depend on the extent of the forests and on the number of people living in them.

A new conclusive testimony of the tendency of jungle yellow fever to pass from one region to another is given by the fact that during the past few years fatal cases have occurred among persons of middle age who were born and always lived in the same locality.

It has been observed that in regions where the seasonal temperatures

are sharply defined infected human cases only occur during the warm season. How the infection is perpetuated from season to season is still unknown.

In a letter to the Commission in October Bauer describes the changes that have been made in a vaccine which has been taken into use. The virus is modified by prolonged cultivation in a medium of 10 per cent of normal monkey serum and embryonic chicken tissue from which the central nervous system has been removed. Following on culture for several years in a tissue poor in nervous tissue elements the virus loses the greater part of its neurotropic and viscerotropic virulence. When the living virus is injected into a monkey (i.e. *rhesus*) there is no development of yellow fever, but a solid immunity is obtained. Similar results have been obtained with human volunteers.

More than 200,000 persons have been vaccinated in Brazil alone according to this method. The results were very satisfactory. About 90 per cent of the persons vaccinated did not show any reaction; among the 10 per cent remaining the reactions were very variable, generally on the sixth to the eighth day after injection. The reaction was generally slight and consisted in slight general malaise, slight headache, and dorsal muscular pains lasting one to three days. In some cases there was a severe reaction with fever lasting two to three days. There have been no deaths and no post-vaccinal complication such as jaundice.

Serum taken from persons a month after injection of the virus shows the existence of immune bodies in 95 per cent of the cases. The development of the antibodies takes place very slowly. The titre of the immunity in the vaccinated appears to increase during the first three months and then remain at a constant level. It is impossible to say at the moment how long the immunity lasts. The serum of some persons tested six months and a year after injection showed no diminution of the degree of immunity.

Surgeon-General Cumming, delegate from the U.S.A., presented to the Yellow Fever Committee during the Session of May, 1938, a report by Dr. Soper, delegate from the Rockefeller Foundation at Brazil. Soper states that they are now using in Brazil a pantropic virus known as "17 D" to the exclusion of all other strains. In 1936 Theiler and Smith found that the virus which Wray Lloyd submitted in 1934 to passages on chicken embryo, deprived of brain and spinal cord, had lost its viscerotropic and neurotropic properties without any diminution of its antigenic power. They concluded that this strain could be used for vaccination without the simultaneous injection of immune serum. Strain "17 D" has now replaced the strains previously employed, with the addition of immune serum by Sawyer, Lloyd and Kitchen, and Lloyd, Theiler and Ricci.

The risk of introducing infection of yellow fever by vaccination in a



locality not infected appears to be infinitesimal, for Whitman, although he had been able to infect *Aedes aegypti* in the larval stage by exposing it to an enormous concentration of virus "17 D," could neither infect nor immunize the *rhesus* monkey by the bite of these *A. aegypti*. Whitman equally failed to infect *A. aegypti* by making them bite persons and animals inoculated with virus "17 D." These results confirm those of Roubaud, Stephanopoulo and Findlay, who have failed in their attempts to infect *A. aegypti* with the virus preserved on chicken embryonic tissue.

As regards the general situation in relation to yellow fever, Soper states that observations during the past three months have shown in a striking manner the importance of jungle yellow fever as a hygiene problem of the first importance. An enormous region covering parts of the States of Minas Geraes and Rio de Janeiro has been infected this year. This has been associated, as in recent years in Brazil, with a marked mortality among monkeys which have been found dead in the forests. The results of several thousand protection tests with the serum of wild animals, commenced in 1934, confirm the opinion that many varieties of monkeys are probably the most important vertebrate factors in the dissemination of the jungle virus. Collections of insects have been made in the infected zones, and experiments indicate that many kinds of mosquitoes are the active vectors of the virus at the time when human cases are produced. The mode of preservation of the virus from season to season in the south of Brazil, where every year several months pass without any human cases being reported, has not yet been cleared up.

At the full meeting on May 13, 1938, the Yellow Fever Commission, after a general discussion on the notes presented, directed its attention specially to the following points:—

(1) The value of the mouse protection test for the diagnosis of yellow fever.

(2) The risk of transmitting yellow fever virus by persons recently vaccinated.

(3) The employment of prophylactic vaccination against jungle yellow fever.

(4) The control of the vitality of the vaccine, of post-vaccinal immunity and its duration.

The mouse protection test was considered to have only a relative value for the diagnosis of yellow fever. It is valuable when the number of positive cases is definitely greater than the average of positive cases in the general population, provided that in testing these positive cases after cure, a sufficient interval of time had elapsed in those subjects who gave a negative protection test before their illness.

As regards the transmission of yellow fever virus by persons recently vaccinated, certain recent events have shown that the virus not attenuated

by prolonged culture on tissue can be found in the peripheral circulation especially if it has been used without the addition of immune serum and can be transmitted by a mosquito which has bitten a recently vaccinated person. But a virus such as "17 D" has the following advantages: (1) its virulence seems to be much attenuated, is stable and non-reversible; (2) it has not been possible to transmit the virus experimentally by the bites of mosquitoes; (3) the virus grown on embryonic tissue does not require the addition of immune serum.

As regards the employment of vaccination against jungle yellow fever the Commission considered two resolutions adopted by the Permanent Committee at its meeting on May 12, 1936.

The first resolution was that vaccination can be advocated for persons exposed to the risk of contracting yellow fever by reason of permanent or temporary residence in a region where yellow fever exists. The Commission agreed to the retention of this resolution. The second resolution stated that mass preventive vaccination was not to be envisaged whatever the method employed, and the greatest prudence was recommended as regards the employment of mouse neurotropic virus, especially when used without the addition of immune serum. The Commission, knowing the importance of exercising great prudence in the use of virus not attenuated by culture on embryonic tissue, did not retain this second resolution, which has been replaced by the following statement:—

As regards jungle yellow fever the Commission ascertained that in Brazil mass vaccination had been in vogue from 1937, thanks to the new method of preparing an attenuated vaccine by culture on tissue. From a practical point of view they considered this biological method to be the only means usable for the prophylaxis of a jungle population against yellow fever. This conclusion did not mean the abandonment of all other prophylactic methods, such as sanitation, and above all measures against mosquitoes, which had proved valuable in the prophylaxis of yellow fever in towns.

As regards the control of the vitality of the vaccine and post-vaccinal immunity and its duration, the Commission consider that before use each lot of vaccine should be tested for vitality and titrated for virulence. Tests for immunity should not be made until one month after vaccination. At present it is not possible to fix the duration of the immunity acquired by vaccination.

## Clinical and other Notes.

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### A CASE OF SUBCUTANEOUS RUPTURE OF THE PANCREAS

BY MAJOR G. MOULSON,  
*Royal Army Medical Corps.*

FUSILIER J., a recruit of one month's service, was admitted to the Royal Herbert Hospital, Woolwich, about 3 p.m. on September 6, 1937, with the following history:—

Half an hour after his breakfast on the day of admission, he ran into a single strand of fencing wire, whilst engaged in physical training. He attributed the accident to the glare of the sun in his eyes, which prevented him from seeing a taut strand of plain wire, that struck him transversely across the upper abdomen. The injury was followed by acute colicky pain in the affected region, accompanied by vomiting. He was transported to hospital from his depot at Hounslow by ambulance the same afternoon.

On arrival in hospital, the patient looked pale, but otherwise displayed no evidence of shock. At times he rolled on his right side when gripped by a spasm of pain; and a small amount of vomit, brought up during examination, contained bile and partially digested food. Running transversely across the epigastrium, from one subcostal angle to the other, could be seen a red wheal on the skin, where the wire had struck him. His temperature was 98·4 F. and his pulse 56 beats per minute. On inspection the abdomen moved normally with respiration, and the superficial reflexes were present. On palpation, there appeared to be tenderness and resistance in the epigastrium, which was most marked in the region of the gall-bladder. The lower abdomen was quite soft. On percussion, there was a suspicion of dullness in the right flank.

The patient's condition was recorded on an hourly pulse chart. Hypnotics were forbidden, and only sips of water were allowed by mouth. A contusion of the stomach wall was considered to be the most likely cause of his symptoms.

At 10 a.m. the following day it was noted that the pulse-rate had risen slightly to between 72 and 80 beats per minute. Intermittent vomiting and epigastric pain, colicky in type, continued. The lower abdomen was still quite soft, but resistance in the upper abdomen appeared to have increased.

By 1 p.m. the pulse-rate was 100, and at 2.30 p.m. it had increased to 120. Examination now showed obvious distension of the upper

abdomen, and definite dullness to percussion in the right flank. The urine was normal in all respects. After premedication with alopon and scopolamine, an emergency operation was begun at 3.15 p.m. under nitrous oxide, oxygen and ether anæsthesia.

The upper abdomen was opened through a right paramedian incision and exposure of the peritoneal cavity was followed with such an alarming amount of hæmorrhage that none of the contents could be inspected, and there seemed to be every prospect of the patient bleeding to death on the table undiagnosed.

In sheer desperation the pedicle of the spleen was seized between thumb and fingers, and the bleeding suddenly stopped.

The stomach, duodenum, gall bladder and visible portions of the liver appeared to be intact. The lesser sac was distended with blood, which was emerging through the foramen of Winslowe. The distribution of the hæmorrhage resembled that occurring in a case of ruptured pedicle of the spleen, which had been under my care two months earlier and had made a successful recovery after splenectomy.

In order to obtain access to the spleen, a transverse incision was made from the original incision, dividing the left rectus muscle. Delivery of the spleen out of the wound, after mobilization, showed the body to be intact, but as the pedicle was suspect, splenectomy was proceeded with and accomplished without difficulty.

Now, with the spleen removed and the lesser sac widely opened, it was appreciated for the first time that there was a large circular tear in the middle of the anterior surface of the body of the pancreas, which involved the peritoneal covering derived from the posterior layer of the lesser sac. The size of the lesion was that of a half-crown piece.

As far as possible, the opening was reduced in size by means of a purse-string suture, but it could not be completely closed on account of the friable nature of the tissues. For greater security, the posterior wall of the stomach was sutured over the site of rupture by two or three stitches introduced through the sero-muscular coats. One end of a large india-rubber drainage tube was inserted down to the lesser sac, and the abdomen was closed in layers.

Operation was followed by intravenous infusion of one and a half pints of gum-saline solution in order to tide the patient over the period pending the arrival of the blood donor.

Five hundred cubic centimetres of citrated blood were transfused at 6.15 p.m., and subsequent progress was satisfactory, though intermittent hiccough and epigastric pain were troublesome for the first few days.

Michel's clips were removed on September 13, 1937; skin sutures on the 15th; and the drainage tube on the 18th, on which date discharge from the wound had practically ceased.

Daily examination of urine following the operation showed no trace of glycosuria, but analysis of the fat content of the stools on September 15 was as follows: Total fat, 33·93 per cent; unsplit fat, 19·35 per cent; split fat, 14·58 per cent.

On September 21, by which time the patient's temperature and pulse rate had been normal for ten days, a slight cystic swelling was noted behind the transverse portion of the abdominal scar. The patient's general condition remained good during the succeeding week, but the swelling and tension in the epigastrium and left hypochondrium became daily more marked, and on September 28 a diagnosis of pancreatic pseudo-cyst was arrived at. A note written on this date reads: "There is a prominent cystic swelling behind the upper half of the left rectus muscle, which extends into the flank. The swelling is dull to percussion. Aspiration of the characteristic fluid with an exploring needle confirms the diagnosis."

*Second Operation.*—As the most prominent part of the swelling coincided with the upper fibres of the left rectus muscle, the abdomen was opened on October 4 under intratracheal anæsthesia, through a left paramedian incision. Incision into the peritoneum passed directly into the cavity of a large cyst containing greenish brown viscous and somewhat opalescent fluid, which escaped under tension and was collected for examination. Excision of the sac wall, where possible, is put forward as the ideal treatment for this condition, but in this particular case it was frankly impossible. The wall of the sac, though  $\frac{1}{4}$  to  $\frac{1}{2}$  in. thick, was rough on the inside, and so friable that it tore away on the gentlest handling, and some of the contained fluid escaped into the general peritoneal cavity, in spite of elaborate packing off with gauze rolls. A supra-pubic drainage tube was inserted into the peritoneal cavity for safety, and the original incision was closed, except for a large drainage tube which fitted tightly into the marsupialised opening of the cyst. The fluid evacuated amounted to three or four pints, and the pathological report on the fluid was as follows:—

"Diastatic index—3300. Trypsin present. Reaction is faintly alkaline. Microscopy shows red and white cells, epithelial cells and fatty acid crystals."

On October 6 the pelvic drainage tube was removed and the patient had his worst day since the onset of his illness. He presented all the signs and symptoms of the onset of paralytic ileus, but eventually responded to intravenous and rectal salines and repeated stomach wash-outs. An injection of heroin a  $\frac{1}{6}$  of a grain at midnight on this date was followed by sleep and a very marked improvement when he awoke on the following morning. No more vomiting occurred. On October 10 the tube draining the cyst was expelled by coughing.

Digestion of the abdominal wall was becoming marked by October 13

and there was a large funnel-shaped ulcer where the drainage tube had been. An effort had been made to protect the skin in this neighbourhood by painting with white of egg, but on this date a plasmon oats poultice was employed instead and continued twice daily.

On October 14 it was evident that the cyst had re-collected and an X-ray film of the chest taken on this date was reported on as follows:—

“The heart is displaced upwards and to the right. The left cupola of the diaphragm is raised to the level of the 5th rib in front. The left lung shows some increased density in its lower half due to compression.”

*Third Operation.*—On October 15 an exploring needle introduced upwards, forwards and medially, through the left costo-vertebral angle tapped fluid. Under local anæsthesia, assisted by administration of gas and oxygen, an oblique incision in this region was gradually deepened until the exploring needle could be traced into the cyst wall, which was then incised between two fixation sutures and drained of two or three pints of fluid. In appearance, the fluid was lighter in colour than on the first occasion, but the contents on analysis were much the same, and pancreatic ferments were present.

The depth of the cyst wall from the skin surface on this occasion made the introduction of a long rubber drainage tube a matter of some difficulty. Eventually closed drainage was established, the tube being stitched to the cyst wall and the skin, and brought out through the dressing. The distal end was later inserted into a bottle of lysol attached to the bed. For the first few days, ten to twelve ounces of fluid drained into the bottle in each twenty-four hours.

At this stage in the illness the patient had wasted to mere skin and bone, and some means of combating pancreatic deficiency seemed to be a matter of necessity. Parke Davis and Co. recommended their panteric tablets as the most suitable preparation. Beginning on October 13, two tablets were given three times a day until, in all, ninety had been consumed. On October 20 a second transfusion of 500 cubic centimetres of citrated blood was given with much apparent benefit.

Closed drainage had to be discontinued the following day (i.e. on the seventh day) as the patient became restless in consequence of being chained so long to his mattress by means of a long tube emerging from his back. The tube was cut short, and thereafter the wound surrounding it was dressed twice daily with about two ounces of plasmon oats (freshly boiled) to stay digestion of the abdominal wall. This was completely successful, and it was remarkable to witness the complete disappearance of the porridge between successive dressings. By this time the excavation in the anterior abdominal wall was healing well.

A severe attack of diarrhoea on November 4 was easily controlled by oral administration of hot alum and milk, and discontinuance of the panteric tablets on the following day.

The posterior drainage tube was removed on November 9, and all discharge finally ceased on November 22.

Even now the patient was not out of the wood, as he suffered from a troublesome cough accompanied by a low-grade evening pyrexia and a rapid pulse beat, varying between 90 and 120 beats per minute.

Eighty cubic centimetres of a clear pleural effusion were aspirated from the left pleural cavity on November 15, and thereafter a definite milestone of progress was passed. His weight two days later was 6 stones 11½ pounds, and he steadily gained until he weighed 8 stones 5½ pounds on discharge from hospital on February 12, 1938.

The analysis of the fat content of the stools on the date of discharge showed: Total fats, 26·4 per cent; split fats, 11·36 per cent; unsplit fats, 15·04 per cent.

The urine was free of sugar, and all wounds had been completely healed since January 8, 1938.

Points of interest arising out of this case appear to be:—

(1) The possibility of subcutaneous rupture of the pancreas occurring half an hour after a meal, when presumably the stomach was comparatively full.

(2) The insidious onset of really severe signs and symptoms corresponding to the period which elapsed between injury to the pancreas and rupture into the lesser sac through the posterior layer of peritoneum (about twenty-four hours).

(3) The control of pancreatic hæmorrhage at the operation by obliteration of the splenic pedicle. This is explained anatomically by the fact that the area injured owes its blood supply to four or five branches supplied direct from and to the main splenic artery and vein.

(4) The formation of a traumatic pseudo-cyst in spite of free drainage of the lesser sac for twelve days.

(5) The rapid reformation of the cyst, when anterior drainage failed after seven days.

(6) The success of posterior drainage through the left costo-vertebral angle and preservation of the abdominal wall from erosion by pancreatic juices when plasmon oats were used as a dressing.

(7) The extreme emaciation which appeared to be checked by the oral administration of Parke Davis and Co.'s panteric tablets.

(8) The complete absence of glycosuria throughout.

(9) The appearance of permanent scars on the back of the patient resembling the lineæ gravidarum on the abdomen of multiparous women. These were caused by the action of enzymes contained in the pancreatic

discharge, which, collected in the creases of the dressings, were in contact with portions of the skin for many hours on end.

#### SUMMARY.

A case of traumatic subcutaneous rupture of the pancreas is described, occurring in a young male, aged 18, and treated by splenectomy associated with the repair of the pancreatic lesion, followed by blood transfusion.

The formation of a traumatic pseudo-cyst, occurring as a sequela, in spite of free drainage of the lesser sac, is worthy of note. The advantage of posterior over anterior drainage of such a cyst is well illustrated. The technique employed in both cases is given in detail.

The complications encountered in the treatment of this case included wasting, diarrhœa, paralytic ileus, low grade pneumonia, pleural effusion and digestion of the abdominal wall.

The eventual recovery of the patient after five months in hospital. His weight on discharge registered  $3\frac{1}{2}$  pounds less than that shown on enlistment one month before the accident.

I am indebted to Colonel A. D. Stirling, D.S.O., Officer Commanding, The Royal Herbert Hospital, for permission to send this case for publication.

I offer my thanks to Lieutenant E. W. O. Skinner, R.A.M.C., who most ably anæsthetized the patient on three separate occasions, collaborated in the ward treatment, and through the kind offices of a good friend at St. Mary's Hospital, Paddington, introduced me to plasmon oaks as a surgical dressing for use in cases of cysts of the pancreas.

My thanks are also due to Major A. Mearns and Major S. M. Burrows, R.A.M.C., for pathological and radiological investigations respectively; to the nursing staff for their care, interest and skill, and to the management of Parke, Davis and Co., for recommending and supplying "panteric tablets."

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## AN INTERESTING ABNORMALITY.

BY MAJOR K. FLETCHER-BARRETT,

*Royal Army Medical Corps.*

PTE. B. came under my care complaining of an enlargement of his fifth left toe, which had been present from birth, and which occasioned difficulty in fitting him for boots or shoes. No similar condition is present in any member of his family.



Examination showed that the small left toe was greatly enlarged; its extremity having a suggestion of being bifid. There were two nails, one on either side of the site of commencing bifurcation. There was no other abnormality to be seen by the naked eye, and movements were normal.

Radiography showed the presence of an unusual bony abnormality. The fourth metatarsal is branched at its distal extremity into two processes of bone, each having an apparently normal head at its distal end. One branch articulates with the proximal phalanx of the fourth toe, whilst the other articulates with a markedly enlarged proximal phalanx of the fifth toe. At its distal end the phalanx of the fifth toe articulates with two

small masses of bone which are the fused middle and distal phalanges of two toes. The condition is very clearly shown in the accompanying photographs.

I am indebted to Major J. C. Coutts, Royal Army Medical Corps, for the X-ray examination and to Lieutenant-Colonel G. A. Blake, Officer Commanding, British Military Hospital, Murree, for permission to forward a note of this case.

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## Echoes of the Past.

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### ANCIENT ALEXANDRIA.

BY MAJOR S. J. L. LINDEMAN, M.C.,  
*Royal Army Medical Corps.*

ALEXANDRIA was founded by Alexander the Great in 331 B.C., and grew rapidly into the leading city of the world. It was fortunate in having a succession of capable and far-seeing rulers to whose efforts its success was mainly due.

It reached its zenith in the first century B.C., at which time it had about half a million inhabitants and was therefore nearly as big as at the present day.

It was the chief centre of learning and scientific knowledge of the world. Most of the leading Greek scientists came over, attracted by the good pay and pensions offered for teaching in the famous museum or university.

Euclid propounded his theorems in Alexandria and the standard of knowledge was extraordinary. One scientist put up a high pole at the harbour entrance and another similar one in upper Egypt. By measuring the angle of the sun's shadow cast by these two poles he calculated the diameter of the earth to within 2 per cent of what is now known to be the correct answer. Another man drew a map of the then known world which showed the whole of Africa, Europe up to Norway, including the British Isles, and Asia as far as the coast of China. Wherever there was an area about which he had no information he left a blank and did not, as was usual in later centuries, fill it up with dragons and sea serpents.

The library contained some 70,000 volumes including the originals of most of the famous Greek plays, which were obtained by a trick. One of the rulers was a great book collector, but like many book collectors, better at borrowing than returning. He sent over to Greece to borrow the plays. He was told they would only be sent if he deposited fifteen talents of gold. He paid the deposit and the books were sent. He had copies made, kept the originals and returned the copies saying they could keep the deposit.

When Alexandria was eventually captured by the Arabs in the seventh

century the Arab Commander was asked by his subordinates what they should do with the library. He said that if it contained what was in the Koran they knew that already and didn't want it, whereas if it contained teaching not in the Koran it was heretical and wicked and must be destroyed so it had better be burnt in any case.

It was completely destroyed and not a trace left ; even its exact site is a bit uncertain.

The town was built on the square plan now known as the American plan, that is all the streets ran north and south or east and west. At least two of the original main streets remain to this day and are now called Rue Fouad I and Rue Nebi Daniel or street of the Prophet Daniel but not the same as the Biblical Prophet Daniel. Where these two roads cross is still a main road-crossing and has been so for over two thousand years. It is interesting to reflect that Julius Caesar probably had a traffic policeman at this point to see that the chariots did not crash. The tomb of Alexander the Great is known to be situated a hundred yards or so from this cross-roads but owing to the overbuilding of the area it is not possible to get at it.

Just off shore from the town was the small rocky island of Pharos which was at first joined to the mainland by a causeway. This has gradually become filled up on one side by silt and debris and on it are built the dock areas of the present day and the more modern harbour. On this island was built the famous Pharos lighthouse from which all other lighthouses have taken their names. It was built about 290 B.C. and quite rightly was one of the seven wonders of the world. It was a third higher than the present usual wireless broadcasting masts and it was built in three tiers, the top being circular. It had a revolving arrangement of reflectors which gave a flash to the light which was visible for thirty miles. The light was provided by burning faggots. They had some kind of telescope, of which the details have been lost, by which they could tell what a ship was as soon as it was within range. The light burned for a thousand years when the upper part fell down in an earthquake, but it went on spasmodically till the fourteenth century. Later the stones were used to build forts round about and only the base of the original lighthouse remains.

The great Cleopatra seems to have been a very clever and designing woman. According to legend she had made up her mind that she must make a hit with Caesar and got herself smuggled into his presence wrapped up in a roll of carpets. Her ruse was remarkably successful and their son Caesarion was born in the Royal Quarter which was situated at the eastern end of the old harbour.

Caesar took her back to Rome with him but she was not a social success there as he already had a perfectly good wife at home, and this was one of the reasons for his downfall.

Later she was equally successful with Anthony and when they were living in a palace on the shore at the base of what is now the Silsilla breakwater, she showed how tactful she could be. Anthony was an enthusiastic fisherman and like most amateur fishermen in Alexandria he did not catch very much but he used to fish assiduously out of the palace windows. She used to send a man down to put a fish on his hook from time to time so that he should not be too disappointed. It is at the far end of this breakwater that she is supposed to have committed suicide.

Christianity came early to Alexandria and Saint Mark lived and taught at a school just outside the town. After a time he fell out with the local authority and in the course of a wordy argument was thrown over the cliff and killed. He was buried in the town and at the time of the Arab conquest some seven centuries later, his remains were rescued by the Venetians and taken over to Venice.

It was in a small school near the present docks that Athanasius and his young friend started their arguments which led to the first great split in Christianity.

An enthusiastic authority on ancient Alexandria now is Mr. A. H. Armstrong who is very kind in taking parties round. An afternoon with him is most interesting. We visit first of all the recent excavations for building purposes beside the British Consulate; here are numerous old foundations extending all round the area and are probably the theatre. Not far away at a corner of the small garden between the Cecil hotel and Ramleh station is the point where Cleopatra's Needle stood for centuries, and it seems a pity it was ever taken away.

Then to Chatby where St. Mark lived and where a specimen catacomb has been reconstructed above ground with its niches and several good headstones round about. In the small museum here are photographs of figures showing the fashions and coiffure of Greek times, pottery, lamps and metal bowls and goblets which are exactly like our modern prize cups.

Next we go back through the centre of the town passing Ramleh tram station on the site of the ancient Cæsareum, on the steps of which Hypatia was killed, and out to a small hill in the slums at the back of the town where stands Pompey's Pillar.

On this hill there was originally a big temple for the worship of Serapis which goes back anyway to 1300 B.C. You can see the snake of Æsculapius on some of the stones. The religion and worship got mixed up at times, but even after the coming of Christianity this teaching of peace and healing led to great rivalry. On one occasion 600 Serapic priests were massacred here by the Christians.

The Christians, or whoever destroyed the Serapium, did their best to deface all the fine carvings and figures. They did pretty well, but there are still some very beautiful pieces remaining. There are several lovely

figures of women wearing pleated skirts. Some perfect cartouches with animals, insects and birds, such as the Nile goose, part of a magnificent hawk in black and gold granite and a Pharaoh's face of the middle kingdom. Two Sphinxes with almost undamaged faces with such soft and peaceful expressions as to suggest that the answer to the riddle of the Sphinx might be "The Peace of God which passeth all understanding."

When the Emperor Diocletian captured Alexandria he did not, as was the custom of those days, put the population to the sword. They were so surprised and pleased that they put up a pillar in his honour. The shaft of the pillar is one piece of red granite brought from Assouan and weighs 300 tons. It is a marvel how they ever got it upright on this plateau at the top of a hill; it would tax modern engineering efforts to erect it. The height is 88 feet and diameter 8 to 9 feet. The foundation is composed of several blocks taken from other buildings, one of these is upside down and has on it cartouches dating to 1300 B.C. Another is of black marble and another the base of some statue with the name "Parasites" on it. It was wrongly named Pompey's Pillar by the Crusaders when they first saw it; they knew Pompey had been killed here and thought it must mark his tomb. A subsequent conqueror of Alexandria was laughed at by the local youths and retaliated by massacring many hundreds of them just below this monument.

From here we go to the main catacombs half a mile away. They were rediscovered by accident about forty years ago. A workman digging a hole for foundations fell suddenly through into one of the upper chambers. They are 80 feet deep and carved out of the solid rock. The main ventilating shaft is like a well with a spiral staircase round the side and leads down to water level. At the bottom is the ceremonial temple where the bodies reposed for a time; there are various recesses and niches leading off it, all the walls being covered with most beautifully cut symbolic scenes. There are the Sun, Hawk, Bat, Bull, and Crocodile Gods depicted in different episodes of life and death in all of which the suggestion is of a continued existence.

On one side of the main temple is quite a large square room which was the dining chamber in which the funeral feast was held. The guests reclined on cushions on a raised plinth all round the room with a ledge in front of them for the plates and were served from the space in the centre.

After a time in the ceremonial temple the bodies were put into the various family or sect niches cut out of the sides of the numerous corridors running in all directions. These all still contain bones and debris. The temple and corridors are now lit by electric light but are otherwise untouched.

There is a second layer of catacombs below but they are under water. All attempts to pump them out have failed, so that it is thought the water level must have altered slightly in the last 2,000 years.

Finally one can visit the site of the Pharos lighthouse and as you sit on one of the stones of the original base and gaze over the glorious blue of the Mediterranean you can ponder on how much or how little things really change in the course of centuries. The Roman Emperor Severus who visited Alexandria in the first century A.D. and afterwards went to Britain left it on record in his diary that the chief amusements of the people of Alexandria were two: watching horse races and watching naked ladies dancing. Races and cabarets are still very characteristic of Alexandrian amusements.

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### Current Literature.

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ROBERT, DERVILLÉE & COLLET. L'intoxication professionnelle par la diphénylamine dans l'industrie des poudres. Étude clinique, expérimentale et prophylactique. [**Occupational Poisoning by Diphenylamine in the Powder Industry. A Clinical, Experimental and Preventive Study.**] *Méd. du Travail*. 1938, v. 10, 49-65.

Diphenylamine is toxic; but its manufacture is done without any exposure of the workers. It is used particularly in the powder industry for rejuvenating gun-cotton which has lost its explosive and detonating properties. For this purpose, it is steeped in vats containing alcohol to which diphenylamine has been added. The effect is to preserve the explosive property of the gun-cotton and prevent it from disintegrating. Formerly, when this process exposed the workers to the absorption of diphenylamine, trouble resulted. To-day, such care is taken that no cases have occurred for a long time; nevertheless, at times of emergency, exposure might again occur. The poison may gain entry to the body by the digestion, the skin or the lungs. The symptoms experienced were intense fatigue, weakness, headache, vertigo, loss of weight and appetite, vomiting, cyanosis, dysuria with high-coloured urine, and, in the case of skin affection, eczematous and vesicular dermatitis. Details are given of a few clinical cases. Experiments with rabbits, rats and guinea-pigs produced similar symptoms with, in addition, fatal diarrhoea when the dose was too great. These animals were given doses by mouth, by inhalation and through the skin. The worst form of exposure was found to be for the workers inhaling fumes of alcohol charged with the diphenylamine arising from the steeping vats. Prevention lies in reducing exposure to a minimum by enclosing all apparatus and observing such hygienic measures as taking no food in workplaces and careful washing after work.

E. L. COLLIS.

Reprinted from "*Bulletin of Hygiene*," Vol. 13, No. 7.

WYATT, S., & LANGDON, J. N., assisted by F. G. L. STOCK. **Fatigue and Boredom in Repetitive Work.** *Med. Res. Council. Indust. Health Res. Board Rep. No. 77.* pp. iii + 77, 8 figs. 1937. London : H.M.S.O. [1s. 3d.]

The general aim of the inquiry was to study the nature, causes and prevalence of boredom and discontent among operatives employed on simple types of repetitive work

Since boredom and discontent are personal experiences which cannot be directly observed or measured, evidence of their existence must primarily depend on introspective data. In this investigation workers were encouraged to express themselves freely in conversation and also to answer specific questions.

The workers were employed in four different factories situated in widely different parts of the country. Results were obtained from 355 workers. Of these, about 3 per cent apparently never suffered from boredom, 33 per cent were slightly affected, 38 per cent experienced a moderate degree, 23 per cent suffered severely, and 3 per cent were seldom free from boredom.

Boredom was fairly frequent during the first hour of the spell of work, but still more common during the second hour, decreasing steadily towards the end of the work period.

Results showed that (a) boredom depressed the rate of working; (b) workers of inferior capacity tended to work more closely to their maximum than did workers of superior capacity; and (c) the rate of working when learning an industrial process was reduced when the worker was bored.

The amount of boredom experienced was dependent on personal characteristics and seemed to be associated with (a) intelligence, (b) inability to mechanize simple manual processes, (c) temperamental tendencies, and (d) a desire for creative as distinct from repetitive work. Singing and talking afforded relief to some, and it was found that gramophone music played about the middle of a work-spell increased the output.

MAY SMITH.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

FITZGERALD, J. G., FRASER, D. T., MCKINNON, N. E., and ROSS, MARY A. **Diphtheria—a Preventable Disease.** *Lancet.* 1938, Feb. 12, 391-7. 7 figs. [15 refs.]

— . **Diphtheria—a Preventable Disease.** [Correspondence.] *Ibid.* Mar. 26, 750.

In the registration area of Canada in the years 1921-25 diphtheria was responsible for 4,635 deaths, of which 42 per cent took place at ages 0-4 and 37 per cent at 5-9. It was the chief cause of death at ages 2-14, accounting for 1 in 7 of all deaths at those ages. Prior to the use of toxoid

there was no effectual control of the disease and in spite of the free distribution of antitoxin for prevention as well as treatment the recorded morbidity rate maintained a high level, and mortality, though falling, presented one of the most important public health problems. In 1925 formol toxoid was distributed to the provincial and local departments of health throughout the country, and it is pertinent to inquire with what result. The authors of this paper bring together the available statistics from various sources. Discussing initially the most effective immunization procedure, they quote figures derived from titrations of the blood-serum of children who initially had no antitoxin and were then submitted to different methods of immunization. Three doses of unmodified diphtheria toxoid induced a higher antitoxin response than two doses, and similarly a better result than either one dose or two of alum-precipitated toxoid. Approximately one year after three doses of toxoid 31 out of 32 children still had 1/100 unit or more of antitoxin per cubic centimetre of blood-serum, compared with only 8 out of 36 who had had one dose of alum-precipitated toxoid. After two years the corresponding figures were 18 out of 21 and 4 out of 26. The level induced by three doses of antitoxin is fully comparable with that found in natural immunes, but this level tends to fall with time (the latter result, it may be noted, was obtained from the titrations of blood-serum of children living in an environment almost free from diphtheria). These results are confirmed by observations in the field.

In Toronto, 1926-30, while diphtheria was still very prevalent, 27,000 school children treated with toxoid could be compared with the remaining 90,000 untreated. In those who had one dose of toxoid the actual attack rate was 29 per cent below the expected rate (i.e. at the rate of the controls under same exposure, corrected for age, etc.), in those who had two doses it was 74 per cent below, and in those who had three doses 90 per cent below. The same reduction is recorded for the last group in the years 1927-32. To the end of December, 1937, there was only one death from diphtheria in Toronto of a child given three doses of toxoid—in a child 6½ years old, immunized five years previously. From 1925 to 1936 inclusive sufficient toxoid had been distributed for the immunization of over three million persons, and strikingly low morbidity and mortality rates have been observed in various cities and provinces. The abruptness of the decline, coupled with the established efficiency of toxoid, justifies its attribution to active immunization. For instance, in the city of Hamilton the morbidity and mortality rates showed no change beyond epidemic waves between 1905 and 1925. They then fell precipitously and there have been no deaths at all since 1930 and no cases since 1933. In Toronto the morbidity rate fell from 164 per 100,000 in 1930 to 3.5 in 1934; in 1921-25 the average annual deaths numbered 65, in 1933-37 the figure was only 3, in spite of an increasing population. Other instances are given. Every province has shared in this decline, but not equally. Surveys in different areas show striking reductions in the number of carriers discovered,



and thus no evidence that immunization of part of a community increases the hazards.

Between the end of August, 1937, and the end of January, 1938, the reported attack rate from diphtheria in England and Wales has been four to five times as high as the rate in Canada, and the widespread employment of toxoid in the latter would appear to be the only factor that can account for it.

[Epidemicity may, of course, affect the magnitude of the difference over the relatively short period of time.] A. BRADFORD HILL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

HETTCHÉ, H. O. & HETTCHÉ-ADAM, M. Die Bedeutung der Schule für die Übertragung der Corynebakterien. [The Importance of the School in the Transmission of Corynebacteria.] *Arch. f. Hyg. u. Bakt.* 1938, v. 120, 34-48. [23 refs.]

In all 1,095 school children in Munich were examined. Among classes free from diphtheria (937 children) 9 carriers were detected (0.96 per cent): 2 strains were virulent, 4 weakly virulent, 3 avirulent. In the classes in which cases of diphtheria had been reported (158 children) there were also 9 carriers (5.7 per cent); 7 of the strains were virulent, 1 weakly virulent, 1 avirulent. The carriers had places in the classes near those of the children who had had diphtheria.

Among the children 24.9 per cent of carriers of pseudo-diphtheric organisms were found. Here too the carriers tended to sit near together. Of 326 strains isolated and tested with regard to sugar and urea reactions, about five-sixths split urea but not sugar. About one-sixth attacked neither sugar nor urea. In one instance the transmission of the pseudo-bacillus was particularly clear; three children sitting near one another were concerned, and in each a rare strain free from urease was involved. In all 0.3 per cent of the tested strains did not ferment urea and gave the sugar reactions of strains of diphtheria.

M. GREENWOOD.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

CARRUTHERS, H. L. Immunity Studies in Diphtheria. *M. J. Australia.* 1938, v. 1, 59-62.

A study was made of immunological response of 105 Schick-positive children to injections of formol-toxoid (anatoxin). Before immunization each child was submitted to a Moloney test, and as a result of this test the children were divided into a Moloney-positive and a Moloney-negative group. Members of the Moloney-negative group were given a first dose of 0.5 cubic centimetre toxoid and a Schick test was made three weeks later. If still Schick-positive the children were given 0.75 cubic centimetre toxoid. After a further interval of three weeks the Schick test was repeated and those requiring a further injection were given 1 cubic centimetre toxoid. The Moloney-positive group were given smaller doses of toxoid, which

varied according to the intensity of their Moloney reaction. In the Moloney-negative group 16 (27.1 per cent) became Schick negative after the first injection of 0.5 cubic centimetre toxoid, and another 38 (64.45 per cent) after the second dose of 0.75 cubic centimetre, so that 91.55 per cent became negative after two injections of toxoid. In the Moloney-positive group 46 children were treated with varying doses of toxoid. Of these 20 (43.3 per cent) were Schick negative after the first dose of toxoid and 16 (34.75 per cent) after the second injection, i.e. 78.05 per cent were Schick negative after two injections. The high percentage of Schick negatives after one dose of toxoid in both groups is remarkable. It is probable that many of the children, particularly those in the Moloney-positive group, were possessed of latent immunity before the commencement of the treatment and reacted to the first dose of toxoid with the anamnestic ("secondary stimulus") type of response.

Among the 105 children there was agreement between the Moloney and pseudo-Schick reaction in 77. Of the 28 cases where there was lack of agreement between the two tests 22 were Moloney positive, Schick pseudo-negative and 6 were Moloney negative, Schick pseudo-positive. It would therefore appear that the Moloney reaction is a safer indication of previous sensitization than the Schick pseudo-reaction.

C. C. OKELL.

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## Reviews.

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POST-GRADUATE SURGERY. Vol. III. Edited by Rodney Maingot, F.R.C.S. Pp. xiv + 3575-5584. London, Medical Publications Ltd. Price £3 10s. per vol.

This volume, comprising another 1,960 pages, is the last of the three volumes of this work. The first chapter is on the Medical Aspects of Surgery, by R. Sleigh Johnson.

Then comes a most clear and helpful section on Hernia, by W. H. Ogilvie; Plastic Surgery, by T. Pomfret Kilner; Obstetric Surgery, by A. W. Bourne; Cardiovascular Surgery, by A. J. Cokkinis; Surgery of the Lymphatic System, by various Authors; a Continuation of Orthopædics, by St. J. D. Buxton. This section includes a short account of Bone Tumours and an excellent account of the Treatment of Fractures, by St. J. D. Buxton and H. L. C. Wood. It is noted that in future editions the whole subject of orthopædics is to be incorporated in one volume—which will be a definite improvement.

Surgery of the Eye is dealt with by F. A. Williamson Noble; the Ear, by F. W. Watkyn-Thomas; the Nose, by P. J. Jory; there is a short

chapter on Endoscopic Surgery, by R. J. Cann. Malignant Tumours of the Pharynx and Larynx are dealt with by Lionel Colledge; Tonsils and Adenoids and Retropharyngeal Abscess, by Charles Keogh; Tongue, Mouth and Lips, by Stanford Cade; Œsophagus and Diaphragm, by Laurence O'Shaughnessy; the Mandible, by Cecil P. G. Wakeley; Fractures of the Mandible, by W. Kelsey Fry; Teeth, by G. Bowdler Henry; Venereal Disease, by A. Malcolm Simpson; Physical Medicine, by Sir Robert Stanton Woods; Deep X-ray Therapy, by M. Walter Levitt.

Part XXXVIII is an excellent section headed: "Some Aspects of General Surgery," by Harold Dodd, which includes Shock, Continuous Drip Blood Transfusion, by H. L. Marriott and A. Kekwick; Gangrene, Burns, Perianal Suppuration; Pilonidal Sinus and Lumbar and Cisternal Puncture.

The concluding section is "Some Neurological and Psychiatric Aspects of Surgery," by T. Rowland Hill.

The three volumes form a monumental work on surgery. It is a magnificent book of reference for practical surgery and operative technique which should prove of the utmost use, especially to surgeons in places far away from reference libraries.

The only adverse criticism is the size of the respective volumes; they are very large and heavy. It would be an advantage to have more and smaller volumes which a weary surgeon could sit and read at his ease. Abdominal Surgery would make a reasonable volume, also Orthopædics, and various other sections could be arranged in a similar manner.

The editor, contributors and publishers are all to be very highly congratulated on what must be one of the finest productions in the literature of British surgery.

J. W.

**MEDICINE FOR NURSES.** By C. Bruce Perry, M.D., F.R.C.P. 1938. Pp. xii + 211. Edinburgh: E. and S. Livingstone. Price 5s. net.

This small book of about 200 pages contains much useful and interesting information for those responsible for the nursing of the sick. The first chapter is devoted to a general consideration of disease and the part played by heredity, nutrition, environment and exposure to infection in its production.

Anæmia is next dealt with, the various types of blood diseases being briefly considered and treatment indicated. This is followed by a chapter on disease of the circulation, explaining in a lucid manner the problems which may confront the nurse dealing with diseases of this system.

Under diseases of the respiratory system the importance of free ventilation, light clothing and adequate fluid in pneumonia is emphasized. The volume, as the author states in the preface, is primarily intended for

nurses studying for the final examination for the Certificate of General Nursing of the General Nursing Council. It can be highly recommended for these students and to many others interested in the care of the sick.

PRACTICAL PROCEDURES. Edited by Sir Humphry Rolleston and A. A. Moncrieff. Pp. 293. London: Eyre and Spottiswoode, Ltd. Price 10s. 6d. net.

This book is compiled from a series of practical articles which have been published in the *Practitioner*. They have been written by different writers. This leads in some cases to a difference of opinion. For example, in one chapter the use of cocaine is advised for anæsthetizing the urethra, in another it is condemned. Against such trifling drawbacks must be set the fact that each contributor is writing about a subject of which he has expert knowledge. For example, the chapter on Poisoning and its Treatment has been written by Sir William Willcox; Marriott and Kekwick write on intravenous infusions; and Sir Henry Cauvain on plaster-of-Paris technique. The subjects have all been dealt with in sufficient detail to be of real practical help to those who have to undertake minor surgical procedures, but lack the practical experience. Though primarily intended for this class of reader, there are few who will not find some helpful tip in it. Altogether it is a most useful and readable book, and one which can be confidently recommended.

C. M. F.

THE BIOLOGY OF PNEUMOCOCCUS. By Benjamin White, Ph.D., with the collaboration of Elliott Stirling Robinson, M.D., Ph.D., and Laverne Almon Barnes, Ph.D. 1938. Pp. 799. New York: the Commonwealth Fund. London: Humphrey Milford, Oxford University Press. Price 20s. net.

This book is a review of all the literature on the bacteriological, biochemical and immunological characters of the pneumococcus, and forms part of the work which was carried out during the years 1931 to 1935 by the Massachusetts Department of Public Health under a grant from the Commonwealth Fund. It is a comprehensive work and deals with the subject in great detail.

There are seventeen chapters and at the end of each there is a summary which is very useful in assisting the reader where such wealth of detail is displayed. The first chapter deals with the history of the pneumococcus and the subsequent chapters are concerned with its various aspects.

Special reference may be made to the chapters on pneumococcal dissociation and transformation, and on the pathogenicity of the pneumococcus for experimental animals and for man, in these the subject matter is clearly set out.

In the chapter on the chemical constituents of the pneumococcus the

authors treat this complex problem at length, but emphasise that the last word has not yet been written about pneumococcal polysaccharides, and with that no one will disagree.

Turning to the chapter on the production of anti-pneumococcal serum, this part of the book contains much information of a specialized nature and indicates that current methods for determining the potency of serums are not altogether satisfactory, which may account for the divergence of opinion on the efficacy of serum in the treatment of the disease.

In addition to the various chapters there is an excellent appendix which is concerned with special methods used in the study of the pneumococcus and in the preparation of anti-pneumococcal serum. This is a particularly useful section of the book and includes such information as the preparation of suitable media, the various methods that may be employed to type the organism and the procedure adopted in the preparation of diagnostic serum in the rabbit. Finally there is a complete bibliography and a good index.

The authors deserve great praise for the masterly way they have produced this work. To write a book of such size around a single coccus is an instance of the vastness of the subject of bacteriology.

MODERN TREATMENT IN GENERAL PRACTICE, 1938. Edited by C. P. G. Wakeley, D.Sc., F.R.C.S.  $8\frac{1}{2}$  by  $5\frac{1}{2}$ . Pp. xii + 440, 113 figs., including 28 plates. London: Baillière, Tindall and Cox. Price 10s. 6d.

We are now beginning to look forward to the annual appearance of "Modern Treatment in General Practice," the fourth volume of which has recently been published. It consists of some fifty-two articles, each contributed by an expert in his subject, and altogether a wide field of medicine and surgery is covered. It is impossible to mention all the articles in a work of this nature, but reviewer considers some of the chapters are worthy of special note, being full of very valuable and helpful advice. Amongst these are the chapters on acute and chronic cholecystitis by the Editor himself, and the chapters included under the heading of Pitfalls in Diagnosis of abdominal conditions, by Sir John Fraser, L. C. Norbury, P. Manson-Bahr, S. W. Patterson and Harold Dodd. The book is brought to a close by five articles dealing with lesions of the skin by various authors, all of which are well worth special study. It is certain that this book will be equally as helpful as its forerunners to practitioners and to medical officers of the Army who may wish to find the latest and most practical lines of treatment of the conditions with which this volume deals; they will not be disappointed, for within its pages they will find what they seek briefly but clearly set forth.

R. P.

WHAT'S WHAT AND WHO'S WHO. By J. A. Sinclair Pooley. 1938.  
Pp. xii + 265. London: John Bale, Sons and Curnow, Ltd.  
Price 5s.

Here is an unusual and important book which can best be described as a reference book to world affairs to-day. It is intended for newspaper readers and those interested in current political events, giving as it does in concise form details of Treaties, Pacts, Conventions, and short biographies of men whose names are household words. The man-in-the-street, with little time to read books by well-known historians, has but a vague general impression of the Versailles Treaty, the Pact of Paris, the Locarno Pact, etc., and when confronted with references to them in his morning paper—often his only source of information—tries to remember what he had read about them and wishes he had a small book to which he could refer. At times too he feels that he would like to know something of the lives of the Dictators and the men associated with them. How and why have they made such profound changes in the condition of their countries? How for instance was Dr. Schacht able to provide the funds for Germany's rearmament?

All this information, and much more, he will find in "What's What and Who's Who," by J. A. Sinclair Pooley, with a Foreword by Vernon Bartlett.

Mr. Pooley tells us that he has tried not to give any bias to any event chronicled. He has endeavoured to stick to the facts and let people form their opinions. In dealing with geographical questions he has tried to show the possible trend of events under certain conditions. While in the case of most of the events described there is a plain statement of facts, one may perhaps not altogether agree with some of Mr. Pooley's contentions, as for instance the origin of the Civil War in Spain. But even here well-known writers have disagreed.

It may be possible to share Mr. Pooley's impression, after exploring the subject matter of this book, that it is a dangerous practice to coin phrases; but it is impossible to believe in the "complete and absolute cynicism of the rulers of all countries to-day."

A most helpful book, which should be in the possession of all those interested in world affairs to-day.



## Notices.

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### TENTH INTERNATIONAL CONGRESS OF MILITARY MEDICINE AND PHARMACY, WASHINGTON.

THE forthcoming International Congress (Tenth) of Military Medicine and Pharmacy will be held in Washington, May 7 to 15, 1939. Invitations to participate have been sent to every country by the President of the United States, and already acceptances have been received from several countries. A full scientific and social programme has been arranged and will shortly be mailed to all the countries to which invitations were sent. A large registration is hoped for, and every effort will be made by the Committee in charge to make the Congress an attractive one to those participating. General Charles R. Reynolds, the Surgeon-General of the United States Army, will be the President of the Congress. Registration is open to all officers of the medical services of the Army, Navy, Air and Colonial Services, National Guard, Territorial Forces and Public Health Service, whether Active or Reserve.

Colonel Harold W. Jones, of the Army Medical Corps, is Secretary-General. The Secretarial office is at the Army Medical Library, Washington, D.C.

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### INTERNATIONAL PHYSICIANS' LUNCHEON CLUB.

THE International Physicians' Luncheon Club of New York extends a most cordial invitation to physicians visiting New York to be honoured guests at an excellent international luncheon, at the same time offering the services of the members of the club for any information they may desire.

While guests are not requested to make speeches, any useful information they wish to give informally will be greatly appreciated as fostering medical progress and international goodwill among physicians from all over the world. Luncheon is served at the International Medical Centre, 135, East 55th Street, New York, every Tuesday, punctually at 1 o'clock and is over about 2 o'clock. Physicians are kindly requested to inform the club of their presence not later than 9 a.m. Tuesday, by telephoning Wickersham 2-7900, or writing International Physicians' Luncheon Club, 135, East 55th Street, New York.

---

### TREATMENT OF ASTHMA BY ORAL INHALATION.

THE symptomatic treatment of mild to moderate attacks of asthma by means of oral inhalation of adrenaline solution of a strength of 1:100 is described by Graeser and Rowe in their original article (*Journal of Allergy*,

1935, 6, 415). These authors found that in many cases the physiological effect of adrenaline occurred with greater rapidity from oral inhalation of a 1:100 solution than when hypodermic injection of the 1:1,000 solution was used; side effects, such as nervousness and tachycardia, were rarely caused; and the discomfort and inconvenience of hypodermic injection could well be avoided. A preparation of the requisite strength for this treatment is now made available by Burroughs Wellcome and Co. as 'Vaporole' Solution of Adrenaline, 1:100. The solution is sprayed into the mouth from an atomiser while the patient inhales deeply; dosage is adjusted to individual needs and is easily found by experience. Any atomiser delivering a fine, evenly-distributed spray may be used, but for effectiveness and durability no better apparatus could be selected than the "Paroleine" Atomiser, which has a stainless steel delivery tube and is of exceptionally robust construction throughout.

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The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

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A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed— "The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."

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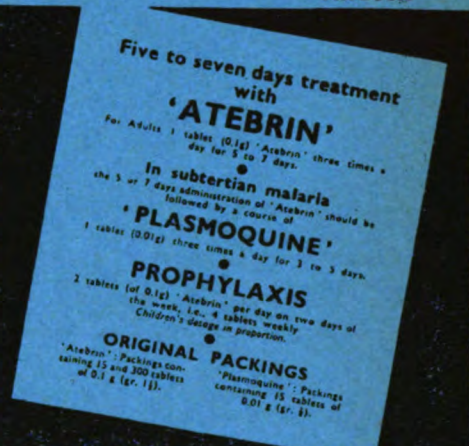
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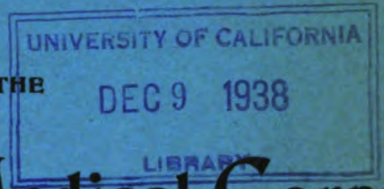
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THE PURIFICATION OF WATER SUPPLIES BY  
UNITS IN THE FIELD.

BY LIEUTENANT-COLONEL E. F. W. MACKENZIE, O.B.E., M.C.,  
*Royal Army Medical Corps.*

RIDEAL (1910) first drew attention to the beneficial effects of ammonia on the bactericidal powers of chlorine. Race (1918) applied these observations to water purification and considerably increased our knowledge of the ammonia-chlorine process. In treating the Ottawa water supply he introduced ammonia in the form of ammonium sulphate followed by chlorine derived from bleach. Harold and Ward (1924) further extended our knowledge and demonstrated the superiority of chlorine gas over chlorine derived from bleach. The superior germicidal power of pre-formed chloramine over bulk-formed was also demonstrated.

As a result of this valuable work, attention was again directed to Race's process and it was taken up by the Metropolitan Water Board, by whom ammonia was administered as the sulphate and chlorine in its gaseous form.

Harold (1926) devised a method for applying the ammonia-chlorine process to water purification in the field. The apparatus designed for the provision of chlorine in gaseous form was ingenious and effective, but was presumably considered too fragile and was not adopted by the Army, although the writer has seen it in use in India.

The ammonia-chlorine process was subsequently adopted by many organizations responsible for water purification on a large scale, and

although it was not universally successful it was rightly accepted as a great advance on former methods, provided it was correctly applied.

The above proviso is of importance since it soon became evident that a method suitable for one water might prove to be unsuitable for a different water.

As a result of the successful application of the process in civil practice the attention of the Army was again drawn to it. Some years of experimental work resulted in the introduction of the Elliott mobile water purifier, and of the Harold-McKibbin method for the treatment of water in water carts or in small quantities in the field (Army Manual of Hygiene and Sanitation, 1934.)

The Elliott apparatus is described in the Army Manual of Hygiene and Sanitation as follows: "A small petrol engine drives a dynamo and pump. As the water is sucked into the pump it is dosed with a sterilizing agent 'chloramine' produced by the interaction of ammonia and sodium hypochlorite. The latter is made by the electrolysis of a dilute salt solution. By increasing or decreasing the electric current the amount of chloramine can be regulated as desired; about 2 parts in 1,000,000 are normally required.

"The water thus treated is then forced through a cloth filter, which is in duplicate. If one filter becomes blocked, the other can be taken into use, thus ensuring a continuous flow of water.

"The chemicals used are ammonium sulphate and salt, both of which are cheap and readily obtainable. To dispense with scales and weights, saturated solutions of these are carried in stoneware jars and diluted as required."

The water purifier has an output of 1,200 gallons of purified water per hour and has proved successful in the field. It provides adequate filtration, is operated by skilled personnel, and dosage can therefore be regulated to meet varying conditions. Since it is used for the provision of purified water at established water points, the contact time may be prolonged if necessary, and the circumstances of its operation resemble closely those existing in civil practice.

The Harold-McKibbin method applies the ammonia-chlorine process to the treatment of water in mobile tanks by the addition of fixed doses of ammonia in the form of ammonium chloride tablets, and of chlorine derived from chlorosene, a stabilized bleach containing 30 per cent available chlorine. The prescribed dose supplies to the water a chloramine concentration of between 1.3 and 1.6 p.p.m. The contact period necessary to effect sterilization by this process is stated to be one hour.

The method embodies neither of Harold's (1924) findings to the effect that chlorine gas is superior to chlorine derived from bleach and that "pre-formed" chloramine is superior to "bulk-formed," neither of which could be applied in a manner suitable for use by units in the field.

The recent mechanization of the Army, with its resultant increased rapidity of movement, has demanded a process which will effect the purification of unit water supplies with the least possible delay. A method was therefore sought which would provide a safe and taste-free water in fifteen minutes under the most adverse conditions likely to be encountered by units in the field.

A review of the numerous processes available appeared to indicate that none offered so many advantages as chloramine and chlorine, and the choice therefore lay between these two. In so far as could be judged from the available evidence, the following are the factors worthy of consideration in assessing the relative merits of the two processes :—

(1) The tests of time and vast experimental work have shown that chlorine, applied by the method introduced by Sir William Horrocks, is extremely efficient, but that, in the case of some heavily polluted waters, it fails to effect the desired result in half an hour. This failure occurs only with those waters which contain sufficient organic nitrogen to bring about the formation of chloramine, or some allied combination of nitrogen and chlorine, although chlorine only be added to the water. In such waters, in fact, the addition of a small amount of chlorine may lead to the production of a persistent but not an effectual residuum of chloramine. This produces a blue colour with cadmium iodide and starch and so upsets the Horrocks' test.

(2) In the heavily polluted waters referred to above, the Harold-McKibbin method shows no superiority as regards sterilization in one hour. It is, in fact, inferior to chlorine in the same concentrations. Elliott (1933) has demonstrated a progressive loss in the efficiency of chloramine as the chlorine-ammonia ratio falls below 4 to 1. In such water this ratio falls progressively and *pari passu* with any increase in the organic nitrogen derived from pollution. In these circumstances therefore the chlorine-ammonia ratio is upset and a slowly acting form of chloramine results.

(3) Chloramine as applied by the Harold-McKibbin method exhibits a pronounced lag compared with chlorine in similar concentrations. The lethal contact time may be four times that required by chlorine alone (Mackenzie, 1936). Nevertheless chloramine, by virtue of its more stable nature, will deal with a greater load of infection, but only provided the contact time is greatly extended, as is usually the case in civilian practice. The above fact, frequently mentioned by investigators without the accompanying proviso, has led to much misconception regarding the relative merits of the two processes for rapid disinfection.

(4) The Harold-McKibbin method necessitates a minimum contact period of one hour. Chlorine in the Horrocks' dose is effective in half this time and further reduction of time is made possible by increased dosage.

(5) Chloramine provides a persistent residuum which will bring about



the destruction of infection which may be added after purification, even if it is accepted that it does so more slowly than does newly formed chloramine. The advantage of this is not to be minimized, but to assess its true value it is necessary to gauge the probability of access of excremental germs to purified and stored water. It would appear to be a rare contingency.

(6) Chlorine has, in the past, given rise to frequent complaints regarding taste. Chloramine produces a faintly acrid taste which is objected to only by a few sensitive individuals.

(7) Owing to the relatively slow powers of penetration of chloramine, water should be clarified as well as chloraminated (Army Manual of Hygiene and Sanitation, 1934).

The situation may therefore be summarized as follows:—

A. Chlorine administered by the Horrocks' method may fail only when dealing with heavily polluted waters such as the lower reaches of the Thames, cesspit-fed wells in France, or buffalo tanks in India. Such waters are easily recognized as heavily polluted and appropriate measures, such as superchlorination to the extent of 10 p.p.m. followed by dechlorination, should be adopted in dealing with them. They can be successfully purified in a short time by no standard method.

Chlorine alone has given rise to complaints regarding taste on a scale which should never be permitted in future.

B. Chloramine, applied by the Harold-McKibbin method, may fail in the same circumstances as may chlorine.

The Harold-McKibbin method is simple in operation and has not given rise to any serious complaints regarding taste.

The method, on account of its slowness in penetrating particulate matter, is considered unsuitable for the purification of water in small quantities, in which circumstances clarification is usually impossible.

When attention was drawn to the necessity for increased speed, the practicability of increasing the dose of chloramine was considered. This was ruled out because the dose necessary to bring efficiency up to that of chlorine, and at the same time to reduce materially the contact time, was out of the question. An increase in the chlorine-ammonia ratio was also tried but it was found that, if this were increased sufficiently to diminish materially the necessary contact time, chlorinous taste resulted. Thresh (1933) considers, moreover, that the residuum should not be increased beyond well-defined limits and draws attention to possible disadvantages "from a dietetic point of view." It therefore appeared unwise to increase the already high residuum since ill-effects, if produced, would be in the nature of a slight lowering of vitality difficult to detect.

It should here be made clear that the limitations inseparable from chloramine set forth above do not detract from its value as an agent for the

purification of water supplies in bulk by mobile water purifiers or at established water points. In these circumstances close approximation to conditions ruling in civilian practice as regards filtration and length of contact is the rule, and chloramine, if properly applied, may be a most effective agent for purification.

For reasons set forth above, chlorination followed by dechlorination appeared to offer the greatest hope as a means for unit purification, both as regards efficiency and speed, provided the difficulty of taste production could be overcome. Chlorinous tastes may be disposed of by dechlorination. If phenolic bodies are present in a water they combine with chlorine to produce a most offensive iodoform-like taste which can be removed only by activated carbon. It has been said that this taste may be prevented by superchlorination in high degree, but in laboratory experiments this was found not to be altogether the case, though the taste was somewhat ameliorated.

It seemed, therefore, that superchlorination followed by dechlorination by means of activated carbon might prove to be a suitable process for adaptation to the water truck and the purification of water in small quantities.

Hydraffin carbons were kindly supplied for experimental purposes by the British Carbo Union. Excellent results were obtained with these, experimentally, but it was evident that the weight of filters of adequate size would be beyond the capacity of water tank truck chassis, and that certain technical necessities would involve considerable and undesirable complications.

Nevertheless, the fact that this highly efficient form of carbon enables a drinking water of greater purity to be produced, literally from a cesspit and in a very short time, should not be lost sight of.

Experiments were also carried out with a form of active carbon saturated with chlorine gas. This process was considered unsuitable on account of instability of the saturated carbon and other difficulties in the way of its adaptation for use in the field.

The possibilities of Verdunization were considered. The process consists in the continuous administration to water of chlorine in a concentration of approximately 0.1 p.p.m., accompanied by agitation of the water. Continuous feed and exact regulation of the dose would necessitate the addition of undesirable complications to the water truck. Furthermore, the process would be practicable only in the presence of the truck, and an alternative process would be necessary for all occasions on which a truck might not be available. The process was therefore considered to be suitable only for the treatment of water supplies in bulk at established water points, in which situations it would appear to offer advantages.

Attention was then directed to superchlorination followed by dechlorin-

ation by sodium thiosulphate. It was realized that taste troubles due to the presence of phenolic bodies might arise, but these had not been experienced when dealing with water from the Basingstoke Canal, which receives the drainage from large areas of tarred roads. It was therefore hoped that they would be so infrequent as not to invalidate a process which might possess such great advantages. This problem will be fully discussed later.

Experiments were therefore designed with a view to ascertaining the necessary dosage and the most suitable method of applying superchlorination followed by dechlorination with sodium thiosulphate.

A strain of *Bact. coli* Type I was isolated from human faeces for use as an indicator. Before accepting the results obtained it was considered necessary to determine the relative resistance to chlorine of this organism compared with certain intestinal pathogens. This was particularly so in the case of *Bact. paratyphosum* B in view of the finding by Elliott (1933) to the effect that the Rowland's strain of this organism was chlorine resistant.

The work of Fox (1936) in the U.S.A. indicated also that the quantity of water which would constitute an adequate sample required consideration. These investigations opened up several side tracks and became too extensive for a full description to be embodied herein, but the following general conclusions were arrived at:—

(1) The resistance of *Bact. paratyphosum* B (Rowland's strain) to chlorine was confirmed, but this was considered to have been acquired by many years of artificial culture, since organisms of the same type more recently isolated did not show comparable resistance. The *Bact. coli* isolated was therefore considered suitable as a test organism.

(2) When dealing with low concentrations of chlorine (in the nature of 0.2 p.p.m.) the contact time factor is of primary importance. In these conditions, although the vast majority of organisms were destroyed after a very short period of contact, those which survived this first period tailed off and some remained viable after comparatively long contact. On the other hand, if the concentration of chlorine were raised beyond a certain point, which varied with the degree of other adverse factors present, the destruction of all organisms was brought about in a comparatively short time. This may be compared with the effects of heat. When germs are subjected to moderate degrees of heat their death proceeds in accordance with the dynamics of disinfection. If the temperature is raised beyond a certain point, which may vary with the resistance of a particular organism, the death of all is instantaneous.

For the above reasons it was found that, when dealing with the high concentrations of chlorine which it was proposed to employ, fifty millilitres constituted an adequate sample.

The results of the final tests of the waters available are shown in Tables I to V.

In each case ten gallon quantities of water were treated in galvanized iron tanks. At the times stated fifty millilitre samples were transferred to double strength MacConkey broth. The readings were recorded after forty-eight hours' incubation at 37° C.

Chlorine estimations were carried out immediately after addition and after the intervals stated. The organisms producing a positive result were frequently subcultured and identified. In all cases they were identified with the test organism. Chlorine concentrations are expressed in parts per million.

TABLE I.—LABORATORY TAP WATER.

An untreated upland surface water containing particulate matter. pH 6·7.  
Temperature 16·5° C. A one scoop water by the Horrocks' test.

Tank No.	Chlorine (immediate)	Chlorine (30 minutes)	Pollution	Culture readings (minutes)		
				10	20	30
I	1·1	0·6	100,000 <i>Bact. coli</i> per millilitre	A.G.	A.G.	Neg.
II	2·1	1·6		Neg.	Neg.	Neg.
III	2·9	2·4		Neg.	Neg.	Neg.
IV	4·0	3·1		Neg.	Neg.	Neg.
V	control			—	—	A.G.

TABLE II.—ALDERSHOT TOWN WATER SUPPLY.

pH 7·4. Temperature 20° C. A one scoop water by the Horrocks' test.

Tank No.	Chlorine (immediate)	Chlorine (30 minutes)	Pollution	Culture readings (minutes)		
				10	20	30
I	1·1	0·9	100,000 <i>Bact. coli</i> per millilitre	Neg.	Neg.	Neg.
II	2·2	1·8		Neg.	Neg.	Neg.
III	3·0	2·7		Neg.	Neg.	Neg.
IV	4·0	3·8		Neg.	Neg.	Neg.
V	control			—	—	A.G.

TABLE III.—BASINGSTOKE CANAL WATER CLARIFIED IN REGIMENTAL WATER CART.

pH 7·4. Temperature 18° C. A one scoop water by the Horrocks' test.

Tank No.	Chlorine (immediate)	Chlorine (30 minutes)	Pollution	Culture readings (minutes)		
				10	20	30
I	0·8	0·4	100,000 <i>Bact. coli</i> per millilitre	Neg.	Neg.	Neg.
II	1·75	1·2		Neg.	Neg.	Neg.
III	2·6	2·1		Neg.	Neg.	Neg.
IV	3·8	2·75		Neg.	Neg.	Neg.
V	control			—	—	A.G.

TABLE IV.—THE SAME WATER AS IN TABLE III PLUS URINE 1 IN 5,000.

pH 7·3. Temperature 15° C. A two scoop water by the Horrocks' test.

Tank No.	Chlorine (immediate)	Chlorine (30 minutes)	Pollution	Culture readings (minutes)		
				10	20	30
I	1·1	0·5	100,000 <i>Bact. coli</i> per millilitre plus 1 in 5,000 urine	A.G.	A.G.	A.G.
II	2·1	1·6		A.G.	A.G.	Neg.
III	3·1	2·5		Neg.	Neg.	Neg.
IV	4·2	3·6		Neg.	Neg.	Neg.
V	control			—	—	A.G.

This was a severe test though two adverse factors, namely high pH value and extreme cold, were lacking. Both of these may be encountered

frequently in the field. It also appeared probable that the time factor might be reduced to less than half an hour even under the most adverse conditions, without unduly increasing the dose of chlorine. The following test was therefore performed :—

TABLE V.—BASINGSTOKE CANAL WATER CLARIFIED IN REGIMENTAL WATER CART.  
POLLUTION ADDED.

<i>Bact. coli</i>	..	..	..	100,000 per millilitre.
Urine	..	..	..	1 in 5,000.

Temperature was maintained at 0·2° C. throughout, and pH value adjusted to 8·5.  
Ammonias : Free and saline 0·12 part per 100,000.  
Albuminoid 0·01 part per 100,000.  
A two scoop water by the Horrocks' test.

Chlorine added	Culture readings			
	5 m l.	10 min.	15 min.	30 min.
2	A.G.	A.G.	A.G.	A.G.
3	A.G.	A.G.	Neg.	Neg.
4	Neg.	Neg.	Neg.	Neg.
Nil	A.G.	—	—	A.G.

This was regarded as being as severe a test as could reasonably be devised.

From the above tests it is evident that a fixed dose of chlorine of the nature of 3 p.p.m. or alternatively a dose of approximately 1 p.p.m. in excess of that indicated by the Horrocks' test, may be expected to sterilize in fifteen minutes any clarified water likely to be used for drinking purposes. It may be necessary to except from this generalization certain heavily and obviously polluted waters which, as previously stated, must always receive special treatment. At the worst estimate, chlorine administered in either of the above doses provides a more effectual treatment than any which has been used in the past as a routine procedure.

In support of the above conclusions a number of tests has been performed in the water tank truck with water drawn from the Basingstoke Canal. This water is known to be resistant to purification by chemical means. That it contained considerable organic matter is indicated by the fact that at the time of these tests the chlorine deviated in thirty minutes sometimes exceeded 2 p.p.m. and on no occasion was less than 1 p.p.m.

The truck was filled with water, inoculated with a saline suspension of *Bact. coli* and treated with one scoop of W.S.P. per 100 gallons over and above the number indicated by the Horrocks' test.<sup>1</sup> Dechlorination with sodium thiosulphate was performed fifteen minutes after the addition of W.S.P. Fifty millilitre samples were drawn from a tap before treatment, at five and ten minute intervals after treatment, and after dechlorination. Each sample was inoculated into fifty millilitre double strength MacConkey

<sup>1</sup> One scoop contains approximately 2 grammes of water sterilizing powder (referred to W.S.P.). This is a stabilized bleach containing 25 per cent available chlorine.

broth and incubated. Readings were taken after forty-eight hours incubation. The results of all tests were the same and are shown in Table VI.

TABLE VI.

Control (sample drawn before treatment) A.G.	5-minute sample Neg.	10-minute sample Neg.	Sample drawn after de- chlorination Neg.
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In civilian practice low concentrations of chlorine and long contact are the rule, and there are few references in the immense volume of literature on the subject of chlorination to the heroic doses necessarily employed under service conditions.

Nevertheless, the work of Adler (1932) has contributed much to our knowledge, and the results of the present work are in keeping with his dictum to the effect that the residuum necessary to effect sterilization should, after half an hour's contact be between 0·3 and 1 p.p.m. This is practically the dose indicated by the Horrocks' test and it is clearly sufficient for clarified water, unless a shorter contact time be desired.

#### DECHLORINATION BY SODIUM THIOSULPHATE.

A chlorinous taste is inseparable from the administration of chlorine in relatively large doses. It therefore remained to be ascertained whether dechlorination with thiosulphate could be applied in such a manner that taste troubles would be reduced to such rare occurrence as to be negligible.

#### STABILITY OF SODIUM THIOSULPHATE.

Tablets of sodium thiosulphate have been used in the Horrocks' Box for many years and, as far as is known, no complaints regarding lack of stability in tropical climates have been received.

#### FORM OF SODIUM THIOSULPHATE.

Thiosulphate may be used in any of three forms.

(1) As the crystalline salt. This is the commercial "hypo" used in photography.

(2) As anhydrous powder.

(3) As soluble tablets embodying a known weight of the salt.

If used as the powder it may be put up in sealed 2-ounce tins, each tin containing a scoop of such a size that one scoopful is equivalent to the 2-gramme scoopful of water sterilizing powder. The scoop would have a capacity of less than one-third of that of the W.S.P. scoop, and substitution of one for the other would therefore be unlikely. Nevertheless, provided a suitable tablet can be prepared this form is considered to be preferable.

If used in the tablet form each tablet should contain the quantity of thiosulphate equivalent to one scoop of W.S.P., namely 0·8 gramme.

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In whatever form the thiosulphate may be used, it should be packed in sealed containers painted red and clearly labelled "TASTE REMOVER". This should obviate the remotest possibility of its being used for any purpose other than removing taste after chlorination.

### QUANTITY OF SODIUM THIOSULPHATE REQUIRED TO DECHLORINATE A KNOWN QUANTITY OF WATER STERILIZING POWDER.

The chemical reaction between sodium thiosulphate and chlorine appears to vary with concentration, temperature, etc. Practical experiments have therefore been carried out in an endeavour to ascertain the quantity of thiosulphate which is necessary to neutralize the chlorine from a known quantity of W.S.P.

With the waters tested this has been reasonably constant. It appears that the quantity of anhydrous thiosulphate necessary is two-fifths of the weight or  $1/3.5$  of the bulk of W.S.P. added to the water.

Since the thiosulphate imparts no taste to the water and has no deleterious action in quantities greatly in excess of those required, considerable latitude in the dosage is permissible.

### TASTE PRODUCTION.

It is well known that phenolic bodies in water, even if present in very small quantities, give rise to chlor-phenol compounds with a resulting and characteristic iodoform-like taste. It is also known that these phenolic bodies may exist in water as a result of pollution by coal-tar products, or as a result of the presence of certain types of decaying vegetable matter or algal growths.

It was not considered that the occasional production of an objectionable taste in the water could be held to constitute a valid reason for discarding a process which possesses such obvious advantages both as regards efficiency and speed. On the other hand it was fully realized that freedom from taste on the vast majority of occasions is a matter of importance second only to safety. Basingstoke Canal water had been treated on many occasions and at all seasons of the year without the production of tastes. This canal receives the drainage from many miles of tarred roads and, since the canal is not now used as such, it contains a heavy growth of water weeds and algæ in great variety. Reports regarding the absence of iodoform taste in the heavily polluted Thames water at Westminster, after simple chlorination, had been received from the Royal Army Medical College, Millbank.

It therefore seemed probable that taste troubles from this cause would arise only on very rare occasions and that, when such occasions did occur, no difficulty should be experienced in finding an alternative source of supply free from this disadvantage.

Nevertheless, it was considered desirable to investigate as many types of water as could be found within a reasonable distance of the Army School of Hygiene.

Before describing the results of these tests, the following points are worthy of note :—

(1) The first water tested was from the Basingstoke Canal, which at that time contained quantities of decaying vegetation. After treatment the water had an unpleasant taste, perhaps best described as something between soapy and musty. This taste was, at the time, thought to be due to the thiosulphate and nearly led to the rejection of the process. Thiosulphate alone was therefore added to tap water in varying quantities and it was found to be impossible to detect it by taste, even in a concentration 100 times as high as that used for dechlorination.

Owing to its polluted state the raw water could not be safely tasted. Two samples were therefore drawn; one was superchlorinated and dechlorinated; the other was chloraminated. It was found that the same taste was present in more marked degree in the chloraminated water. It is therefore justifiable to suppose that the taste existed in the raw water, and that not only was it not produced by superchlorination, but that this process actually improved the quality of the water.

This experiment has been described at length since it forcibly demonstrates the necessity, in any extensive trials, for full investigation of each complaint by a competent observer. Unless this is done a process may be condemned on the wrongful assumption that it has produced tastes which already existed in the raw water, and which no process other than activated carbon treatment would remove.

(2) This contention is further borne out by another incident which occurred during the tests about to be described. For some days water treated by superchlorination had an objectionable taste. One day the same taste arose in a chloraminated sample. Investigation proved that it was due to one particular tank and the substitution of a clean tank resulted in the disappearance of the taste.

#### EXPERIMENTS TO ASCERTAIN THE PROBABILITY OF TASTES ARISING IN WATERS TREATED BY SUPERCHLORINATION AND DECHLORINATION BY SODIUM THIOSULPHATE.

In order to ascertain whether objectionable tastes which might be recorded were caused by the treatment to which water was subjected, or were native to the waters, it was considered essential that the tests should be controlled.

It was necessary, on account of pollution, to purify the majority of the waters before tasting. The Harold-McKibbin process is known to produce no tastes other than the easily recognised taste of chloramine. For this



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reason the tests took the form of a comparison between the resultant products after treatment of each water by (A) Superchlorination followed by dechlorination, and (B) The Harold-McKibbin method, with a long period of contact. On each occasion a "tasting committee" was formed and the opinion of each individual was recorded secretly. No taster knew to which treatment the water under test had been subjected, or the opinion of the other tasters.

It was early realized that certain individuals were extremely sensitive to chloramine, whereas others were completely insensitive, and for this reason extreme expressions of opinion were carefully considered and were, in all cases, found to be unjustified. Such adverse opinions referred, in all cases, to chloraminated water, and it was found that a high proportion of individuals can detect the standard dose, particularly in very pure waters such as those from the chalk, in which the slight acrid taste of chloramine is not disguised by the natural taste of the water. One individual on one occasion only recorded a "query faintly chlorinous taste" in water treated by superchlorination, and this finding may be discounted since a sensitive observer recorded the same water as "flat."

Controlled tests were carried out on twelve waters in all. These varied in character as far as possible. Details of the waters are given in Appendix I.

In considering the results of these tests it must be borne in mind that the faintest taste was recorded, and that serious objection was taken to chloramine only by chloramine-sensitive individuals. The differences were so slight as to be difficult of detection by the average individual. The same remarks apply to tea made from the waters.

The results of testing the treated waters for taste were as follows :—

In the case of nine waters chloramine produced a taste variously described as acrid, chlorinous, faintly unpleasant, metallic or astringent.

Superchlorination produced no taste in any of the above waters.

In the case of the remaining three waters neither process showed any superiority over the other, and in none of these was any objectionable taste recorded.

From the nature of the waters it is evident that several of them had every opportunity of containing phenolic bodies, whether derived from road washings or from vegetable pollution. Nevertheless, in none of the treated waters was the faintest trace of iodoform taste detected. Whether this was due to complete absence of phenols or their oxidization by the comparatively high degree of chlorination was not ascertained.

These tests indicate strongly that trouble from iodoform tastes will be of such rare occurrence as to be unimportant.

In the case of marshy and pond waters superchlorination did much to remove the earthy taste natural to such waters, and there is no doubt that

waters of this kind are rendered more pleasant by the process. This fact is recognized in waterworks practice. It is well illustrated by the experiences at Glencoe, Ill., discussed by Pflanz (1932).

#### DEGREE OF SUPERCHLORINATION PERMISSIBLE.

Experiments have been carried out to ascertain what degree of superchlorination may be employed. It has been found that a concentration of fifty parts per million of chlorine may be used, if followed by dechlorination, without imparting any objectionable taste to the water. In fact, the concentration permissible would appear to be limited only by the lime-content of the bleaching powder.

The process can be applied in the simplest manner to the purification of water in small quantities, and it is considered that the feasibility of using high concentrations of chlorine for the purification of water in these circumstances, where filtration is usually impracticable, is of the greatest possible value. In routine purification also, the fact that the chlorine dosage may be stepped up almost without limit to meet special circumstances constitutes an outstanding advantage.

#### APPLICATION OF THE PROCESS.

In attempting to apply superchlorination followed by dechlorination to the purification of water supplies in the field in such a manner that the contact period may be reduced to fifteen minutes it would appear, from tests already described, that we are faced by the following alternative methods.

(A) To discard the Horrocks' test and administer a fixed dose of 3 p.p.m. to clarified water, or, for reasons to be given later, 4 p.p.m. to unclarified water, or (B) to retain the Horrocks' test and administer to the water 1 p.p.m. of chlorine in excess of the amount indicated by the test. The latter method has been designated CONTROLLED SUPERCHLORINATION.

In favour of (A) it may be argued that the absence of the Horrocks' test provides simplification, which is so much to be desired. On the other hand, deficiency of available chlorine in bleach has been an everyday occurrence in war, and no method may be considered altogether satisfactory which provides for a fixed dose of bleach without furnishing some means for ascertaining whether or not the chlorine content of the bleach is up to standard. The ability to estimate the chlorine content of the bleach by some method of titration must therefore be assumed to be an essential part of any fixed dose process suitable for general use. This involves either the retention of the Horrocks' Box, or its substitution by some more suitable apparatus for titration; also the training of men in its use. During some years of experience it has been found easier to teach the average private soldier the use of the Horrocks' Box than to teach him to

estimate the percentage of available chlorine in bleach. The strongest argument in favour of the fixed dose is therefore fallacious.

On the other hand the following arguments may be advanced in favour of the retention of the Horrocks' Box.

(1) The test automatically compensates for deficiency of available chlorine in W.S.P.

(2) It automatically compensates for the rapid deviation of chlorine which may be caused by the presence of reducing substances in natural waters. Unpolluted waters which deviate more than one part per million of chlorine are not uncommon in India.

(3) A fixed dose must be sufficient to purify water under the worst conditions likely to be encountered. It is therefore greater than is necessary on most occasions, and for this reason is uneconomical. When waters containing reducing substances are encountered it may prove inadequate, unless grossly excessive on almost all other occasions. The test obviates these disadvantages.

(4) The box supplies the necessary apparatus to enable a medical officer to estimate with reasonable accuracy the percentage of available chlorine in bleach.

(5) It provides the necessary measures for treating water in small quantities by the black cup method, which is applicable to all containers of a size between a water bottle and a water truck (Army Manual of Hygiene and Sanitation, 1934).

The arguments in favour of the retention of the Horrocks' test therefore far outweigh any which may be advanced in favour of its abolition.

Superchlorination controlled by the Horrocks' test would thus appear to be the method of choice for routine purification of water supplies by units in the field.

It has been shown previously that chlorine in a dose of one part per million in excess of the Horrocks' dose is effective in fifteen minutes. It is easy for water-duty personnel to remember that a one-cup water requires one scoop of W.S.P., a two-cup water two scoops, and so on, and any alteration in this may lead to mistakes. In order to administer the extra scoop of water-sterilizing powder necessary to provide the additional 1 p.p.m. of chlorine, and at the same time maintain accord between the number of the cup showing the blue colour and the number of scoops of W.S.P. required per 100 gallons, a modification of the Horrocks' test has been devised.

Details of the test as originally performed are laid down in the Army Manual of Hygiene and Sanitation, 1934, and repetition here is unnecessary. Details of the proposed MODIFIED HORROCKS' TEST are set forth in Appendix II.

As has been stated, the Horrocks' test fully compensates for chlorine deficiency in W.S.P. Unfortunately the test does not compensate for

deficiency in the additional scoop added to raise the residuum from the usual 0·3 to 1 p.p.m. up to the 1·3 to 2·2 p.p.m. considered necessary to reduce the contact time to fifteen minutes. This is illustrated in Tables VII and VIII below. Although approximately correct the concentrations shown are theoretical and serve merely as an illustration.

TABLE VII.

Water sterilizing powder up to strength. (1 scoop W.S.P. per 100 gallons recorded as 1 part per million).

Modified Horrocks' test				Actual state of affairs in a tank dosed with the number of scoops per 100 gals. indicated by the modified Horrocks' test	
Cup	Added	Residual chlorine	Deviated	Added	Residual chlorine
2nd	1 p.p.m.	1 to 0·3	0 to 0·7	2 p.p.m.	1·3 to 2·0
3rd	2 p.p.m.	1·2 to 0·3	0·8 to 1·7	3 p.p.m.	1·3 to 2·2
4th	3 p.p.m.	1·2 to 0·3	1·8 to 2·7	4 p.p.m.	1·3 to 2·2
5th	4 p.p.m.	1·2 to 0·3	2·8 to 3·7	5 p.p.m.	1·3 to 2·2

*Note.*—In line 1 (2nd cup) the residuum cannot be less than 0·3 since this is the smallest amount that will produce a definite blue colour with the indicator solution. If more than 0·7 p.p.m. is deviated the water therefore becomes a 3rd cup water.

In line 2 (3rd cup) the residuum cannot be greater than 1·2, since if less than 0·8 p.p.m. were deviated the water would be a 1st cup water. The residuum cannot be less than 0·3 for the reason given above.

TABLE VIII.

Water sterilizing powder deficient to the extent of 50 per cent of its available chlorine. (1 scoop W.S.P. per 100 gallons recorded as 0·5 p.p.m.)

Modified Horrocks' test				Actual state of affairs in a tank dosed with the number of scoops per 100 gals. indicated by the modified Horrocks' test	
Cup	Added	Residual chlorine	Deviated	Added	Residual chlorine
2nd	0·5	0·5 to 0·3	0 to 0·2	1 p.p.m.	0·8 to 1·0
3rd	1·0	0·7 to 0·3	0·3 to 0·7	1·5 p.p.m.	0·8 to 1·2
4th	1·5	0·7 to 0·3	0·8 to 1·2	2 p.p.m.	0·8 to 1·2
5th	2·0	0·7 to 0·3	1·3 to 1·7	2·5 p.p.m.	0·8 to 1·2

Table VII illustrates how, when the water becomes a 3rd, 4th or 5th cup water through deviation of chlorine, the addition of one extra scoop per 100 gallons furnishes a residuum between 1·3 and 2·2 p.p.m. on all occasions. The residuum is constant between these limits under all conditions, and a fixed dose of thiosulphate may therefore be used for dechlorination.

Table VIII illustrates how, when the water becomes a 3rd, 4th, or 5th cup water through reduction of the available chlorine in the W.S.P. by one-half, the addition of one extra scoop per 100 gallons furnishes a residuum of only 0·8 to 1·2 p.p.m. The residual chlorine becomes progressively lower as the chlorine content of the W.S.P. diminishes, but can never quite reach the minimum of 0·3 supplied by the Horrocks' dose alone.

When using the method only very pure waters would remain "second cup" in the face of serious chlorine deficiency and the dose provided in

such cases would undoubtedly be effective in fifteen minutes. This might not be the case with heavily polluted waters and if fifteen minutes contact were adhered to failure might result. In applying the method we are therefore faced by the following alternatives :—

(A) To suppose that serious deficiency of chlorine in W.S.P. will be detected. Controlled superchlorination involves the retention of the Horrocks' Box. It therefore provides the means for estimating, in a few minutes, the percentage of available chlorine actually present in the W.S.P. The above supposition is therefore a reasonable one, and it would be a simple matter to teach that, on all occasions on which the modified Horrocks' Test indicates more than two scoops W.S.P. per 100 gallons, the chlorine content of the bleach should be investigated and the dose regulated accordingly. This procedure would provide an absolute safeguard against failure resulting from deteriorated W.S.P.

(B) To provide an automatic safeguard under all conditions by laying down that, in the case of 2nd cup waters only, the contact time may be fifteen minutes, but in all other cases not less than thirty minutes should be given.

The majority of waters are "modified 2nd cup," and thirty minutes' contact would therefore be the exception and not the rule. Nevertheless, the proviso introduces a complication which, though slight, is to be avoided if possible. The question whether or not any increase of the minimum contact time of fifteen minutes is necessary must be considered.

Tables I to V show that the only water in which the dose advocated did not provide a wide margin of safety was that used in the experiment set forth in Table V. This water was so heavily polluted with urine as to bring it into the category of waters derived from cesspits which, as previously stated, require special treatment. The adverse factors of high pH value and extreme cold were also present. Furthermore, fifteen minutes is to be considered the minimum contact period and under normal conditions would be extended. It would therefore be necessary to encounter a water such as that described, in combination with unsuspected and serious deficiency of chlorine in W.S.P., extreme cold, and the necessity for drinking the water in fifteen minutes, before the possibility of failure need receive serious consideration.

The adequacy of the degree of compensation for chlorine loss through deterioration of W.S.P. achieved by the modified Horrocks' test has been tested in practice as follows :—

A 200-gallon water truck was filled with water from the Basingstoke Canal. The water was inoculated with a saline suspension of *Bact. coli*.

The modified Horrocks' test was performed with : (A) W.S.P. containing 25 per cent of available chlorine ; (B) W.S.P. containing 12 per cent of available chlorine. (A) gave a blue colour in the 3rd cup ; (B) gave

a blue colour in the 5th cup. The dose of chlorine indicated by (A) was therefore approximately 3 p.p.m., and that indicated by (B) approximately 2.5 p.p.m. As was to be expected, compensation for deterioration of bleach was incomplete. The water in the truck was treated with the quantity of deteriorated bleach indicated by Test (B). Fifty millilitre samples were drawn from the taps before treatment, and at five, ten and fifteen minute intervals after treatment, and inoculated into fifty millilitre double strength MacConkey broth. Results were read after forty-eight hours' incubation.

The bacteriological results are shown in Table IX.

TABLE IX.			
Control (sample drawn before treatment)	5-minute sample	10-minute sample	15-minute sample
A.G.	Neg.	Neg.	Neg.

It will be seen that compensation, although incomplete, was more than adequate and the dose indicated produced a *Bact. coli*-free water in five minutes.

The test may be considered a severe one. The Basingstoke Canal had been low and stagnant for months; it was choked with weed and decaying vegetable matter; the water, although clear, deviated 1.5 p.p.m. of chlorine.

Compensation was not only adequate, but provided a wide margin of safety.

It may therefore be stated with confidence that controlled superchlorination provides a considerably wider margin of safety under all conditions than does any process which has been used in the past for unit purification of water supplies in the field. In addition it possesses the following advantages:—

- (1) The necessary contact time may be reduced to fifteen minutes.
- (2) From the evidence available the production of taste in treated waters which is not removed by dechlorination should be a rare occurrence and, in the case of the majority of waters which have a natural unpleasant taste, improvement results from the treatment.
- (3) The dose of the sterilizing agent may be stepped up almost without limit to meet special conditions which may arise, since no taste is produced thereby and no harmful chemical remains to be consumed by the individual.
- (4) When treating water in the 150-gallon or 80-gallon water tank trailers, the doses appropriate to 200 gallons or 100 gallons respectively may be used. Provided the error is on the side of excess, exact dosage, either with W.S.P. or thiosulphate, is quite unimportant.

It may fail in the time specified only in waters of the cess-pit variety. As has been stated previously, no process which is suitable for routine use, and which will sterilize waters of this type rapidly, has yet been devised. Superchlorination can be adapted to do so by employing a fixed dose in

the neighbourhood of 10 p.p.m. for all waters. This would be so greatly in excess of the quantity required on almost all occasions as to be undesirable on the score of economy in W.S.P. It is, moreover, considered quite unnecessary for reasons already advanced.

Superchlorination followed by dechlorination may be applied also to the purification of water in small quantities, either by the black-cup method or the water-bottle method, both of which are described in the Army Manual of Hygiene and Sanitation, 1934. In these circumstances a Horrocks' Box may or may not be available. If available, controlled superchlorination may be the method of choice. If not available, a fixed dose must be resorted to and a dose of approximately 4 p.p.m. followed by thirty minutes' contact is recommended. The dose has intentionally been made a high one and the contact time has been lengthened for the following reasons :—

(1) In the absence of the modified Horrocks' test there is no compensation for loss of chlorine resulting from either deterioration of W.S.P. or excessive deviation.

(2) When small-quantity methods are used filtration is impracticable. The contact time has been increased to thirty minutes in these circumstances to allow of adequate penetration of particulate matter. Moreover, these methods are unlikely to be necessary in the presence of mechanization. The necessity for speed is therefore less pressing.

(3) Underdosing is liable to result from spilling when measuring the solution in scoops.

(4) When using water-bottle methods it is improbable that thirsty men in a tropical climate can be relied upon to wait for the time specified before drinking, even though the water has not been dechlorinated and may therefore have a chlorinous taste. The dose provided will, in five minutes, purify a grossly polluted water under severe conditions of temperature and pH value (see Table V) and therefore minimizes the risk from the above state of affairs.

(5) A high dose is unimportant from the economic standpoint since small quantity methods are resorted to only for occasional treatment by small detachments.

A comparison as regards simplicity in operation of superchlorination with the Harold-McKibbin method of chloramination is not without interest.

The Harold-McKibbin method undoubtedly offers greater simplicity than controlled superchlorination. There is, however, no justification for such a comparison. Controlled superchlorination has been advocated because it provides automatic and, it is believed, sufficient compensation for chlorine deficiency in W.S.P. The Harold-McKibbin method provides no such compensation. The correct comparison is therefore between the Harold-McKibbin method and superchlorination by means of a fixed dose

of 3 p.p.m. of chlorine, or between the Harold-McKibbin method plus some means of estimating the chlorine content of W.S.P. and controlled superchlorination. Operation is as simple with superchlorination by means of a fixed dose as with the Harold-McKibbin method, and efficiency in a limited time is infinitely greater. In the case of the former the addition of W.S.P. is followed by the addition of thiosulphate, in the latter it is preceded by the addition of ammonium chloride.

If chlorine deficiency is to be guarded against when using the Harold-McKibbin method, and this is considered to be essential, it is necessary to estimate the available chlorine in W.S.P. whenever a new tin is opened and before using powder from a tin which has been open some time. The simplest method for carrying out this estimation is at least as complicated as the Horrocks' test, and when performed it leads to a mathematical calculation to ascertain the number of scoops of the deteriorated bleach which would be equivalent to two scoops of W.S.P. containing the full 25 per cent available chlorine. The result usually involves the administration of a fraction of a scoopful unless the chlorine-ammonia ratio is to be upset with resultant decreased efficiency.

This procedure is considerably more difficult to learn and more complicated in performance than is the Horrocks' test. It has moreover proved to be quite unreliable in the hands of average water duty personnel, and its use would be restricted to medical officers.

It may therefore be stated with confidence that, if chlorine deficiency is to be guarded against, controlled superchlorination is more simply taught and easier in application than is the Harold-McKibbin method. Moreover, a sufficient degree of compensation is automatic and is not dependent upon the caprice of whoever may be in charge of the unit water supply and the presence of the medical officer.

Specific detailed proposals regarding suggested methods for use in various circumstances are set forth in Appendix III.

#### SCHISTOSOMIASIS.

In the absence of personal experience of the effects of chlorine on the cercariæ of pathogenic schistosomes, only tentative proposals for the treatment of water in districts in which schistosomiasis is endemic have been made, and a discussion of this subject has been relegated to Appendix IV.

#### SUMMARY.

A brief outline of the steps which led to the introduction of the ammonia-chlorine process for the purification of water supplies is followed by a description of the methods by which the process has been adapted for use by the Army.

The success of the process for the purification of bulk supplies at established water points, when conditions as regards filtration and permis-



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sible contact period approximate to those prevailing in civil practice, is emphasized.

Attention is drawn to the slow sterilizing action of chloramine when prepared by the Harold-McKibbin method, and to the increasing demand for a more rapid process for use by units in the field.

A search has been made for a process which will disinfect drinking water in the Army water tanks in fifteen minutes and which can be adapted, while using the same materials, to the treatment of water in small quantities. Various processes which might appear to meet this demand are considered and the conclusion is reached that, as regards efficiency, speed, adaptability and stability of materials, no other process offers the advantages of superchlorination followed by dechlorination by sodium thiosulphate.

Experimental evidence regarding the efficiency of the process under adverse conditions is produced, and it is claimed that it provides a wider margin of safety in all circumstances than does any process which has been used in the past.

Although it has been considered necessary to direct attention to certain theoretical defects, it is considered that they are largely academic and do not detract from the practical value of the process. These defects, moreover, are shared by chloramine, and indeed by all other processes which are considered suitable for use in the field.

The possibility of taste troubles has received consideration, and the conclusion is reached that these, if not altogether absent, should be of such rare occurrence as not to invalidate a process which offers so many advantages. On the vast majority of occasions tastes which are native to the water are ameliorated or removed.

Specific proposals are made for the application of superchlorination either by means of a fixed dose, or controlled by means of a modified Horrocks' test. The former method is considered to be as simple as the Harold-McKibbin method, and to be more efficient under all conditions in which speed is demanded. It shares, however, with chloramine, though in lesser degree, certain disadvantages inseparable from any process involving the use of a fixed dose. For this reason controlled superchlorination is recommended as the method of choice for routine use, while a fixed dose is advocated only for those occasions when a Horrocks' Box would probably not be available.

Attention is drawn to the practicability of stepping up the dose of chlorine almost without limit. This is considered to be of the greatest value in certain circumstances.

Details of the modified Horrocks' test, specific proposals for the application of the process, and a brief discussion of water purification in districts in which schistosomiasis is endemic have been embodied in appendices.

## ACKNOWLEDGMENTS.

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I desire particularly to acknowledge my indebtedness to Colonel Sir William Horrocks, K.C.M.G., C.B., upon whose classical work "controlled superchlorination" has been based. Such other processes as appeared to offer advantages have been tested, and the results of the tests serve only to emphasize the superiority of the Horrocks' principles. The modifications now advocated in no way alter these principles and have been dictated only by the demands of progress.

## APPENDIX I.

## A.—WATERS IN WHICH SUPERCHLORINATION WAS SUPERIOR AS REGARDS TASTE.

(1) *Bourlay Low Level Supply*.—An upland surface water impounded in a reservoir. The collecting area is composed largely of pine woods and bracken. The water is collected in concrete aqueducts. It is subjected to no treatment.

(2) *Fleet Pond*.—A shallow pond several acres in extent and overgrown with water weed of great variety. Fed by surface drainage and springs. A polluted water.

(3) *Eelmore Flash, Basingstoke Canal*.—Situated fifty yards from a main and recently tarred road, some 100 yards of which drains directly by an open drain into the flash. The sample was collected during wet weather and every opportunity existed for contamination with phenols. The flash also drains a large area covered with decaying vegetation. It communicates directly with the canal, and the water is therefore not altogether stagnant. The natural water had the characteristic earthy taste of stagnant surface water.

(4) *Basingstoke Canal*.—The canal drains miles of country of varying character, and large areas of adjacent tarred roads. It is disused and contains a great variety of weeds and algal growths. The sample was drawn after heavy rain when the water was still loaded with particulate and colloidal suspended matter. The water had a characteristic earthy taste.

(5) *Hawley Pond*.—A natural shallow lake several acres in extent. There is no large feeder. The lake is fed by springs and ditches carrying surface drainage from marshy and moorland country, over which extensive

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falling of pine woods was in progress at the time. The water has a high iron content.

(6) *Frensham Great Pond*.—A lake some acres in extent, fed by springs. Probably little surface drainage or pollution as the lake stands high and is surrounded by sandy soil. Water was drawn from a stream at its exit from the lake.

(7) *River Test, Below Stockbridge*.—A chalk stream; this water was tested because it was understood to have given rise to taste production some years ago. The sample was drawn from a rapid stream flowing over a gravel bed at Houghton Ford. The river was running low and clear.

(8) *Deep Chalk Well at Itchell Pumping Station*.—A typical clear and pure water from the chalk.

(9) *A Heavily Polluted Duck Pond*.—This was a really bad water, muddy, used by ducks and animals. After filtration, it was a pale straw colour.

### B.—WATERS IN WHICH NEITHER PROCESS PRODUCED ANY RECOGNIZABLE TASTE.

(10) *Ditch at Side of Road near Entrance to Rushmoor Arena*.—The ditch drains: (a) Part of the grassy arena; (b) a large marshy and overgrown area to the east thereof; (c) a considerable length of tarred road.

The sample was drawn after heavy rain. The water was yellow ochre in colour and heavily loaded with suspended matter derived from road and other surface washings, and with colloid.

(11) *River Wey at Tilford*.—Selected as a typical river water, taking the surface drainage from a wide area of country, including roads and towns.

(12) *River Mole at Walton-on-Thames*.—A fast flowing stream where water was drawn, shallow with a muddy bed. The water was clear with some suspended matter. A typical polluted river draining a populous district.

### APPENDIX II.

The modified Horrocks' test. (Devised to provide automatically for one scoop of W.S.P. per 100 gallons in excess of the number indicated by the Horrocks' test.)

*Method*.—Clarified water should be used. When used in conjunction with the water tank truck the test should be carried out while the tank is being filled, an operation which takes not less than one hour.

(1) Prepare a standard solution of water sterilizing powder in the black cup as follows: Put into the black cup one level scoopful of water sterilizing powder, and make it into a smooth paste with a little clarified water by stirring it with a glass stirrer and carefully breaking up all lumps.

Add more water to the paste and fill the black cup with water to the mark on the inside. Stir vigorously and leave the glass rod in the black cup. This solution is never clear, as it contains lime in suspension, which, however, gradually settles. Put into this solution one of the glass pipettes.

(2) Fill the six white cups with clarified water to within a quarter of an inch of the top.

(3) Add drops of the standard water sterilizing powder solution from the pipette to the water in the white cups, so that they contain 0, 1, 2, 3, 4 and 5 drops respectively. Stir the contents of each thoroughly with a clean stirring rod and leave this stirring rod in the black cup. Allow the cups to stand for half an hour, shading them from sunlight.

(4) After half an hour add three drops of the indicator solution from the drop bottle to each of the white cups, and stir each with a clean stirring rod.

(5) Some of the six white cups will show no colour, some will show a blue colour. The first of the cups showing a definite blue colour, that is the one containing the smallest number of drops, is noted. Say cups 1, 2, 3 show no colour or only a pale blue, but cups 4, 5, 6 show a definite blue colour, then cup 4 is the one to be noted. If none of the cups show a definite blue colour, the cups are washed out and the test is performed again with 6, 7, 8, 9, 10, 11 drops of the water sterilizing powder solution in the cups.

(6) In the example given in the previous paragraph cup 4 was the first which showed a definite blue colour.

Four scoopfuls of W.S.P. are therefore required per 100 gallons of water to be purified. It will be seen that there can be no one-cup waters, since a one-cup water by the original test becomes a two-cup water by the modified test.

The retention of the contact time of thirty minutes, as in the original Horrocks' test, although contact with the water to be sterilized has been reduced to fifteen minutes, may appear at first sight to be illogical. It has been advocated because deviation of chlorine by organic matter is less rapid than by inorganic and, particularly at low temperatures, may continue beyond fifteen minutes' contact. A water polluted by organic matter, which is a third-cup water after fifteen minutes, may therefore become a fourth-cup water after thirty minutes' contact. The thirty minutes' contact time may therefore indicate a higher dose for water containing considerable organic matter, and in which, therefore, the action of chlorine on bacteria is less rapid. Since the filling of the water tank truck occupies not less than one hour, no delay results from the longer period, and there seems no good reason why the perhaps slight additional degree of safety should be discarded.

## APPENDIX III.

## METHODS AVAILABLE AND DETAILED PROPOSALS FOR THE PURIFICATION OF WATER SUPPLIES BY UNITS IN THE FIELD BY MEANS OF SUPER-CHLORINATION FOLLOWED BY DECHLORINATION.

*I.—For the Purification of Water in the Water Tank Truck, Water Tank Trailer, etc.*

(1) As soon as clarified water is available perform the modified Horrocks' test.

(2) Add to the water the number of scoops of W.S.P. per 100 gallons indicated by the test. Mix. Allow to stand fifteen minutes.

(3) Perform the final test.

(4) Dissolve two tablets of taste remover per 100 gallons in a white cup, add to the water and mix. The water is then ready for use.

If the water is not required for immediate issue, the addition of taste remover may with advantage be delayed until immediately before issue.

*Note.*—The final test as laid down in Army Manual of Hygiene and Sanitation, 1934, indicates only that residual chlorine is present in sufficient quantity to produce a blue colour with cadmium iodide and starch indicator solution. This is not necessarily sufficient to sterilize in the minimum time of fifteen minutes. The test has been retained because it can be performed in one minute by anybody, and at the worst it indicates that the addition of W.S.P. has not been forgotten. If dechlorination is delayed for thirty minutes or longer, as will normally be the case, it indicates that the water is safe. A positive result from the test also precludes the somewhat remote possibility that the taste remover might have been added before the W.S.P.

A new quantitative final test, and a method for titrating the available chlorine in W.S.P. by the use of the 0.8 gramme of thiosulphate proposed for dechlorination, are at present under investigation, and if successful may obviate the necessity for the 1.5 grain tablets of thiosulphate and the bottle of glacial acetic acid at present included in the Horrocks' Box. Alternatively a chloroscope might with advantage be added to the equipment of the vehicle. This would permit of accurate estimations of residual chlorine, and would be in keeping with modern practice. If for any reason it is inconvenient or impossible to perform the Horrocks' test, a fixed dose of one scoop W.S.P. per twenty-five gallons, followed, after the appropriate interval, by dechlorination by one tablet of taste remover per twenty-five gallons, may be substituted for the above method.

*II.—For the Purification of Water by "Small Quantity" Methods.*

A. When a Horrocks' Box is available and the water is clarified.

(1) *The Black Cup Method.*—Perform the modified Horrocks' test with clarified water. The number of the first cup giving a definite blue colour multiplied by the number of gallons to be treated gives the number

of scoopfuls of the solution in the black cup to be added to the water, using the standard scoop issued in the Horrocks' test case.

*Method.*—Add the required number of scoopfuls from the black cup, mix and allow to stand for thirty minutes. While standing dissolve one tablet of taste remover in a white cup full of clarified water. When the thirty minutes is up add two scoopfuls of the taste remover solution per gallon. Mix. The water is then ready for issue.

(2) *The Water-Bottle Method.*—Mix with some water in the black cup the number of scoops of W.S.P. indicated by the Horrocks' test, and pour into a water-bottle labelled "Strong Solution." Fill the bottle with water and shake well.

Add one scoopful of this strong solution to each man's water-bottle full of water. Shake. Allow to stand thirty minutes.

While standing dissolve two tablets of taste remover in a little water in a white cup. Pour into a water-bottle labelled "TASTE REMOVER" and fill with water.

When the thirty minutes is up, add one scoopful of taste remover solution to each water-bottle and shake. The water is then ready to drink.

B. When a Horrocks' Box is not available.

In these circumstances it is probable that the water will not be clarified. The quantities treated will be small and economy in W.S.P. is not therefore demanded.

(3) *The Fixed Dose Water-Bottle Method.*—Mix one scoop of W.S.P. with a little water and pour into a water-bottle labelled "STRONG SOLUTION." Fill the bottle with water and shake well.

Add four scoops of this strong solution to each water-bottle full of water. Allow to stand thirty minutes. While standing, dissolve one taste remover tablet in a little water. Pour into a water-bottle labelled "TASTE REMOVER" and fill with water.

When the thirty minutes is up add four scoops of the taste-remover solution to each water-bottle and shake.

*Note.*—If a large number of bottles is to be treated, four scoops W.S.P. may be added to the strong solution bottle and four scoops of taste remover to the other bottle. One scoopful of each solution is then required per water-bottle of water.

(4) *The Gallon Method.*—Mix four scoops of W.S.P. with a little water and pour into a water-bottle labelled "STRONG SOLUTION." Fill the bottle with water and shake well. Add four scoops of this strong solution for each gallon of water to be treated. (Since a gallon is the equivalent of a water-bottle  $\times 4$  this gives 4 p.p.m. of chlorine.) Mix. Allow to stand thirty minutes.

While standing dissolve four tablets of taste remover in a little water. Pour into a water-bottle labelled "TASTE REMOVER" and fill with water.

When the thirty minutes is up add four scoops of taste remover solution for each gallon of water. Mix. The water is then ready to drink.

It will be seen that there are four tentative methods for the purification of water in small quantities, all of which are based, to some extent, on methods previously in use. Careful consideration of each method and an assessment of its practical value is desirable.

(1) *The Black-Cup Method* is of value for purifying water in pakhals, petrol tins and other small containers. It may be used for this purpose in India as a permanent routine procedure on a large scale. The retention of the modified Horrocks' test has therefore been preferred to a fixed dose.

Two methods for purification in water-bottles have been described.

(2) *The Water-Bottle Method* depends upon the use of a Horrocks' Box. It would seem that, in circumstances in which water-bottle methods are necessary, either a Horrocks' Box would not be available or the necessity for it should be avoided if possible. It is therefore considered that this method may, without disadvantage, be dispensed with.

(3) *The Fixed Dose Water-Bottle Method* requires only a tin of W.S.P. and a tin of taste remover. It provides a wide margin of safety, since clarified water is unlikely to be available under the conditions which demand the use of such methods, and, in the absence of the Horrocks' test, there is no compensation for excessive deviation of chlorine. The method is suitable for all occasions when water-bottle methods are necessary, and it is considered to be the method of choice. (If the water is very cloudy or there is reason to suspect unusually heavy pollution, for example, treating water from buffalo tanks, the doses of W.S.P. and taste remover may be doubled.)

(4) *The Gallon Method* has been devised for the treatment of water in small containers, e.g. pakhals, petrol tins, etc., when no Horrocks' Box is available. It provides the same wide margin of safety as does method (3), for the same reason.

The methods considered to be of sufficient value to justify their retention, and to provide a suitable means for the purification of water in small quantities on any possible occasion, may therefore be reduced to the following three:—

- (1) The Black-Cup Method.
- (2) The Fixed Dose Water-Bottle Method.
- (3) The Gallon Method.

It would be a simple matter to devise a method for individual purification of water in small quantities by means of a small tablet of a stable chlorine compound or a small measure supplying sufficient chlorine to treat one bottle, to be followed by a tablet containing the appropriate dose of antichlor. This would undoubtedly be very convenient when required. On the other hand it would involve the supply of a special article which might be so rarely required that deterioration would be probable. For

this reason proposals for the purification of water in small quantities have been confined to methods involving the use of materials which would be constantly available and rapidly turned over by everyday use.

## APPENDIX IV.

## SUPERCHLORINATION IN DISTRICTS IN WHICH SCHISTOSOMIASIS IS ENDEMIC.

Great diversity of opinion has been expressed regarding the lethal effect of both chlorine and chloramine on the cercariæ of the pathogenic schistosomes.

Leiper (1916) states: "In view of its germicidal value, chlorine 1:1,000,000 acting for half an hour is in common use. This dilution would not have the requisite effect upon the activity of the bilharzia cercariæ. It would be necessary to use two parts of available chlorine per 1,000,000 and afterwards to dechlorinate in order to render the water taken from the canals and ditches in Egypt free from bilharzia infection.

Manson-Bahr and Fairley (1920) confirmed Leiper's findings to the effect that cercariæ can survive exposure to concentrations of over 1 p.p.m. of chlorine for considerable periods.

Blackmore (1928) noted these long survival times, and in an endeavour to ascertain the comparative efficacy of chloramine and chlorine, found that pre-formed monochloramine in a concentration of 1 p.p.m. destroyed cercariæ rapidly, and that chlorine derived from bleach and administered in the dose indicated by the Horrocks' test killed them within the thirty minutes' contact laid down as a routine.

Griffith-Jones *et al.* (1930) carried out a carefully controlled investigation regarding the respective merits of chloramine and chlorine when used for the destruction of cercariæ.

They concluded that chloramine, when manufactured in an apparatus supplied by a well-known firm, was unstable, and that higher concentrations were necessary than when chlorine alone was used. When pre-formed chloramine was manufactured by Harold's water-cart method involving the use of a kettle, the relative efficiencies were found to be reversed. The chlorine used in their experiments was derived from bleach, and the results with chlorine alone are therefore of value for our present purpose. In a series of experiments involving the use of *S. mansoni* and *S. hæmatobium* in both filtered tap water and raw Nile water, the highest doses of chlorine derived from bleach found necessary to destroy cercariæ on any occasion are found in Table A.

TABLE A.

		15 minutes' exposure	30 minutes' exposure	60 minutes' exposure
Tap water	..	4 p.p.m.	3 p.p.m.	2 p.p.m.
Raw Nile water	..	5 p.p.m.	4 p.p.m.	3 p.p.m.



Witenberg and Yofe (1938) consider that a lethal effect is produced in thirty minutes by an initial concentration of gaseous chlorine of not less than 0.8 p.p.m. They also conclude that *S. hæmatobium* is more resistant to chlorine than *S. mansoni*, but that, when exposed to chloramine, the latter is more resistant than the former. A careful analysis of the chlorine estimations on which this conclusion is based, points to the possibility that the apparently greater resistance of *S. hæmatobium* to chlorine may have been due to a higher organic content in the water in which it was put up. The same authors observed that cercariæ, if exposed to chlorine until they "are creeping at the bottom or they are partly swimming above the bottom," do not recover although the chlorinated water be withdrawn at this stage and be replaced by fresh water. This observation, which they term the "irreversibility of the effect of chlorination," may be of importance in determining the minimum lethal concentration under any particular circumstances, since the time taken to produce the effect described above is only a fraction of the time necessary to bring about death.

The very wide discrepancies in the minimum lethal concentrations noted by different observers may be explained, to some extent, by the fact that, in some cases, no attempt has been made to assess the quality of the water either as regards its organic content or its ability to deviate chlorine. There is no reason to suppose that this should have less influence on the dose necessary for the destruction of cercariæ than of bacteria. Its influence on the destruction of bacteria is known to be profound. A further possible explanation may be found in the fact that the cercariæ used were not in all cases proved to be those of the pathogenic schistosomes.

It appears, therefore, that further carefully controlled investigation is essential, and that this should be performed with a variety of waters including those in which the factors known to exert an adverse influence on the destruction of bacteria are present. Only as the result of a reliable investigation of this description will it be possible to lay down a method of dosing with either chlorine or chloramine, which will at all times provide an effectual concentration with reasonable economy, and at the same time permit of the shortest period of contact consistent with safety. Since schistosomiasis is likely to be encountered, for the greater part, in desert countries, reduction in contact time is likely to be of prime importance; this will be particularly so in war.

A study of the results set forth in Table A on page 315 indicates that the concentrations of chlorine necessary to destroy cercariæ in tap water and raw Nile water are correlated and, if the findings of Witenberg and Yofe regarding the irreversibility of the effect of chlorine are confirmed, there is good reason to suppose that the necessary concentrations or contact times may be substantially reduced below those found necessary by Griffith-Jones *et al.* If the above supposition prove correct controlled super-

chlorination, as previously advocated, should suffice to destroy cercariæ in all waters likely to be encountered.

Nevertheless, in the absence of definite proof to the contrary, it must be assumed that the concentrations laid down in Table A are necessary, and it has been considered essential, when using the Harold McKibbin process, to double the dose and to extend the contact time from the one hour laid down to a period of two hours.

From the information at our disposal it must therefore be accepted that any process which will purify water infected with cercariæ will be unnecessarily extravagant in areas in which schistosomiasis is not endemic, and that a special method must therefore be used, at least until the contrary is proved.

It is therefore suggested that, despite its evident disadvantages for the treatment of water in bulk, a fixed dose should be used. The following methods are recommended:—

For treating clarified water in the water-tank truck a dose of 4 scoops of W.S.P. per 100 gallons (4 parts per million of chlorine) followed, after not less than thirty minutes' contact, by four tablets of taste remover.

In emergency the contact time may be reduced to fifteen minutes by doubling the dose.

This double dose would also be effectual in fifteen minutes when treating raw water, and would therefore be a suitable dose for small quantity methods.

The high dose recommended appears to be in keeping with the known facts, after providing an ample safety margin indicated by the absence of the Horrocks' test. Since the residuum is not consumed it can have no adverse influence on health; it tends to produce a more palatable water than do smaller doses; it can therefore be objected to only on the score of economy. It is a very low price to pay for safety of drinking water supplies.

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# SOME PRELIMINARY OBSERVATIONS ON THE EFFECTS OF SUSTAINED MUSCULAR EFFORT IN A HOT CLIMATE WITH ESPECIAL REFERENCE TO THE LOSS OF FLUIDS AND CHLORIDES

BY CAPTAIN N. C. LENDON,

*Royal Army Medical Corps.*

THESE investigations were begun at the British Military Hospital, Peshawar, during the hot weather of 1937—unfortunately a change of station interrupted their further pursuit and it was found impossible to complete the series later. The original intention was to examine a series of twenty British other ranks of whom ten were to have had under six months service in a tropical climate and ten were to have had over five years service under the same conditions. The examination of the six men here reported upon was meant to be a trial of the procedure to be adopted and to indicate which investigations were relevant to the problem under discussion.

*Procedure.*—Six volunteers (three with less than six months and three with more than five years service in a tropical climate) were chosen and went on a route march with the rest of the battalion in the usual way; this route march was a weekly event and no deviation from the usual routine took place on this occasion. The men were told to measure approximately the amount of fluid they drank before the route march; the volume of their drinking utensils was measured the day before and the figures given by the men should be correct within 2 ounces. No special instructions were given as to the taking of extra salt. A “light” breakfast only was eaten shortly before the march began.

Only one man passed urine during the march. On return from the route march the six men came immediately to the British Military Hospital and were examined at once; the volume of water remaining in their water bottles was measured and thereafter all fluid intake and urinary output was measured exactly. The day before the route march the shirt and singlet of each man were carefully washed and then thoroughly rinsed out in distilled water; when dry they were collected by the men and worn by them the next morning. No modifications whatsoever were made in the diets except that each man was given the opportunity of having one bottle of beer (24 ounces) in the evening after the route march: none of the men refused the beer.

Owing to the limitations of time it was found impossible to repeat the blood analysis the following morning. The men were weighed immediately after the route march and again the following morning.

The basal metabolic rate was estimated by Read's formula. It was found that the only practicable method of estimating the chlorides in the sweat was to extract the sweat from the shirts and singlets with distilled water (it is to be noted above that the shirts and singlets had previously been rinsed well in distilled water). The effective area of each shirt and singlet actually in contact with the skin was taken as being approximately 0.56 square metre. It was considered that as there would be a considerable amount of sweat (with its contained chlorides) left on the skin, the estimated amount of chlorides found in the shirt and singlet should be increased by one third in order to give an approximate figure for the quantity of chlorides lost by 0.56 square metre of the body surface. The surface area of the body was estimated in each case by means of Boothby and Sandiford's Nomograph. (No allowance was made for the proportional distribution of sweat glands over the surface of the body.) From the amount of chlorides estimated to have been excreted by 0.56 square metre of the body surface it was possible to estimate the approximate amount of chlorides excreted in the sweat by the whole of the body surface in each case.

#### FINDINGS.

##### *Pulse Rate and Pulse Pressure.*

Immediately after the route march it was found that the pulse-rate of the men with less than six months service was faster than that of the men with more than 5 years service. As a standard of fitness the variation in the pulse pressure was considered to be a good criterion. Judged by this standard the group with more than five years service in India may be said to be relatively fitter than the group with less than six months service.

##### *Basal Metabolic Rate (by Read's Formula).*

It is interesting to note that the rise in metabolic rate in each individual was approximately the same in both groups (hereafter called Group A and Group B respectively)—Group A would appear to have a higher rate than Group B.

##### *Blood Chlorides.*

Group A was found to have a higher blood chloride content than Group B following the route march. This corresponds nearly inversely with the total chlorides lost during the route march.

##### *Blood Urea.*

The blood urea level was relatively much higher in Group A than in Group B.

##### *Blood Sugar.*

Group B had a relatively higher blood sugar level than Group A.

*Urinary Output during the Route March.*

Only one man passed urine during the route march and in every other case the first specimen of urine taken after the route march was passed within half an hour—it is therefore considered that the first specimen of urine represented the “urinary output” during the route march, or more exactly, the renal secretion during that time.

Group A secreted a noticeably large amount during this period. In Group A some relationship seemed to exist between the urinary output and the sweating—this did not hold in Group B.

*Fluid Intake.*

Before the march Group A drank more fluids than Group B. During the route march Group B drank more than Group A. Considering the total fluid intake it is found that with the exception of one man the other members of both groups drank about the same amount.

*Loss of Fluid on Route March, i.e. Sweating.*

Group A lost more fluids than Group B. There appeared to be little correlation between the amount of chlorides lost during the route march and the degree of sweating. It is noteworthy, however, that, with two exceptions, the concentration of chlorides in the sweat was remarkably uniform.

*Chloride Loss during the Route March.*

Group A lost more chlorides than Group B.

Group A lost more chlorides in the urine than Group B.

Group A lost rather more chlorides in the sweat than Group B.

As regards the relative concentrations of chlorides in the sweat, Group B exhibited a more concentrated sweat than Group A. There was an inverse variation between the total fluid lost on the route march and the concentration of chlorides in the sweat.

Group A secreted a urine more concentrated in chlorides than Group B.

In the case of Group A there appeared to be a close relationship between the total fluid intake before and during the march and the total chloride loss—this relationship, however, did not appear to exist in the case of Group B, where the reverse appeared to be the case.

There appeared to be no relationship between the concentrations of chlorides in the first specimen of urine and the sweat.

*Twenty-four Hour Findings.*

Whereas the fluid intake for the whole twenty-four hours was approximately the same in both groups, the urinary output of Group B was greatly in excess of Group A during that time. The total fluid lost through causes other than urinary secretion (e.g. sweating) was much greater in Group A than in Group B.

The total chlorides passed in the urine in twenty-four hours was much higher in Group B than in Group A.

The total fluid lost through other causes (e.g. sweating) in twenty-four hours was much greater in Group A than in Group B—this in spite of the fluid intake being approximately the same in both groups.

*Loss of Weight on Route March.*

Inaccurate though these observations probably are, the findings may be used with a due allowance for error. Group A lost more weight on the march than Group B. This loss of weight was considered to be due to sweating and represented the degree of "dehydration."

*Concentration of Chlorides in Urine.*

(1) *On the Route March.* In the first specimen of urine, as was expected, the concentration of chlorides was markedly high—this was more marked in Group A than in Group B.

(2) *During twenty-four hours.* Group A exhibited a greater concentration of chlorides in the urine than Group B.

*Concentration of Chlorides in Sweat.*

Group B secreted a more concentrated sweat than Group A.

DISCUSSION.

A definite difference appeared to exist between men of short and long service in a tropical climate in their physiological reactions to a sustained muscular effort such as a route march during the hot weather. Thus the basal metabolic rate was raised more in the short service group than in the group with long service. The blood chloride level appeared to be higher in the men of short service in spite of a greater loss of chlorides during a sustained muscular effort. The blood urea level was higher in the men of short service and almost approached a pathological level in one case. The men with long service appeared to sweat less than men with short service—they lost correspondingly less chlorides in this way and excreted a correspondingly greater quantity of urine with a lower concentration of chlorides. During a route march the amount of chlorides lost in the sweat was double that in the urine.

Two individuals with the highest concentration of chlorides in the sweat were considered, on other grounds, to be the least fit men of their respective groups; in the case of one man this was associated with a high total fluid intake before and during the route march—an association which did not exist in the case of the other. These two individuals exhibited the most disturbed physiological equilibrium; in one case a raised blood urea level and in the other an abnormally high blood sugar level with

a low blood chloride level. There appeared to be little quantitative relationship between the degree of sweating and the amount of chlorides lost in this way; the quality of the sweat seemed to be of the greatest importance. In each group it is interesting to notice that the fittest man actually sweated the most during the route march but sweated the least during the twenty-four hours. Group B had the highest urinary output both during the route march and throughout the twenty-four hours, and during the route march Group B drank more than Group A.

It is known that the normal urinary output for the twenty-four hours in a temperate climate should vary between 1,400 and 1,500 cubic centimetres, and that the concentration of chlorides varies round about 500 milligrammes per 100 cubic centimetres of urine. It is considered also by many authorities that chlorides pass through the kidneys as a "filtrate" varying directly as the blood chloride level.

Group A had an average urinary output for the twenty-four hours of 601 cubic centimetres, with a concentration of chlorides varying between 800 and 1,100 milligrammes per 100 cubic centimetres. Group B had an average urinary output of 890 cubic centimetres, with a concentration of chlorides varying between 630 and 950 milligrammes per 100 cubic centimetres. The average chloride output in the urine is given by various authorities as varying between 8 and 13 grammes daily; in Group A the average output was 5.41 grammes and in Group B the average was 7.07 grammes daily.

During the route march itself the concentration of chlorides in the urine was enormously high, varying between 1,500 and 3,300 milligrammes per 100 cubic centimetres in Group A, and between 1,100 and 1,700 in Group B. The total quantity of chlorides lost in the urine in Group A averaged 2.17 grammes, while in Group B the average was 1.92 grammes. The average total chloride loss during the route march for Group A was 6.86 grammes, and for Group B 6.36 grammes.

The approximate amount of fluid, lost through sweating during the course of the route march, was in Group A 6.6 pints, and in Group B 5.4 pints (i.e. about 6 pints, taking both groups together).

In the Army Manual of Hygiene and Sanitation, 1934, it is stated that on a 15 mile march in a temperate climate a man has to get rid of 1,200 calories of heat from his body by evaporation of sweat from the skin—this entails a loss of 2 quarts of water from the body—therefore for every  $7\frac{1}{2}$  miles 2 pints of water are required. Now, in a hot climate, two other factors are at work, viz: (i) simple evaporation from the skin and air passages according to the relative humidity (this evaporation must here assume a very much greater importance than in a temperate climate); (ii) the efforts made by the body to prevent overheating due to the temperature of the environment. *We have found that the water*

requirements of a man marching 8 miles on a day when the temperature is  $104\cdot3^{\circ}$  F. in the shade and the relative humidity 47 per cent requires approximately 6 pints of water in order to maintain real fighting efficiency. Falconer and Lyall, in a recent paper (*British Medical Journal*, December 4, 1937), consider that the basal requirement of sodium chloride in health is less than 1 to 2 grammes per day. They consider that the total amount of sodium chloride in the circulating blood is normally about 30 grammes, with a tissue reserve of probably double that amount, i.e. 90 grammes in all. They consider that the normal daily intake of sodium chloride is 6 to 12 grammes, and that the undoubted benefits of saline administration are dependent more on the correction of the dehydration than on the alteration of the plasma chloride values, and that salt given in normal solution exerts a greater effect on the plasma chloride levels than when given in concentrated solution.

Now, during a route march of nine miles of 3 hours 10 minutes duration (in climatic conditions as above detailed) there was a total chloride loss of approximately 6·6 grammes, i.e. about one-fifth of the chloride content of the blood and about one fifteenth of the total sodium chloride content of the body—the greater part of this total was lost by sweating, and represented a sudden abnormal depletion of the chlorides of the body; the disturbance of physiology which this occasions is evidenced by the abnormal reaction of two individuals who lost most chlorides in this way. As no control observations have been made we cannot say how much this loss of chlorides in the sweat exceeds that of a man doing light duties in the shade. Falconer and Lyall further suggest that 20 grammes of salt are required on the average to raise the plasma chloride by 100 milligrammes per 100 cubic centimetres (from, say, 400 to 500 milligrammes)—now, the average blood chloride level of the six men under observation was 417 milligrammes per 100 cubic centimetres blood, and so it would appear that 16 grammes of salt would be needed to restore the blood chloride level of these men to normal. A normal solution of saline contains approximately 5 grammes of sodium chloride per pint, and if we add 15 grammes of sodium chloride to six pints of water we obtain a  $\frac{5}{6}$  saline solution which we know by experience is not unpalatable to drink.

Now, in the urine the chloride loss was only slightly in excess of what would normally occur in the space of time occupied in this case by the route march—the concentration, however, was very high (between 1·1 per cent and 3·2 per cent)—varying between  $1\frac{1}{2}$  and 4 times the concentration of normal saline (0·9 per cent): the secretion of such a concentration urine must tax the kidneys severely.

In conclusion, it would appear that the main requisites of men marching during the hot weather are a liberal supply of water and an



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opportunity for replacing the sudden loss of chlorides in the sweat which they experience at that time.

It is tentatively suggested, therefore, that each man should be provided with six pints of water containing 15 grammes of sodium chloride for every seven and a half miles marched in a hot climate.

It was hoped that control observations might have been carried out to test the efficacy of this administration of chlorides and liberal fluid allowance and, further, to investigate the blood calcium levels since the early symptoms of heat-stroke appear to be partly tetanic in nature. The effect of administration of glucose was also under consideration.

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## THE REGIMENTAL MEDICAL OFFICER AT ANNUAL TRAINING.

BY MAJOR J. COHEN, T.D.,  
*Royal Army Medical Corps (T.A.).*

THESE notes have been compiled in the hope that they may prove of some assistance to Territorial Regimental Medical Officers.

The following books are required in camp :—

Field Service Regulations, Vol. I, 1930.  
Field Service Regulations, Vol. II, 1935.  
Territorial Army Regulations, 1936.  
Field Service Pocket Book, 1932.  
Royal Army Medical Corps Training, 1935.  
Army Manual of Hygiene and Sanitation, 1934.  
Regulations for Medical Services of the Army, 1932.

### A.—BEFORE ANNUAL TRAINING.

Check your equipment. Medical equipment of units is shown in Regulations for the Equipment of the Army, Part 3, 1935, Table 46.

Indent through your O.C. for any further medical or ordnance stores you will require. Articles often requiring to be supplemented are : Liq. iod. mitis., gauze, cotton wool, 3-inch bandages.

A copy of the arrangements for the evacuation of sick will be sent to you by the A.D.M.S. Read any Standing Orders and Training and Administrative Instructions issued by your Division.

Arrange the time of sick parade with the adjutant of your unit. One hour after reveille is often found most convenient.

Offer to give one or two lectures during annual training. Suitable subjects are : " The Maintenance of Health," " The Prevention of Disease," " Venereal Disease," " The Hygiene of the March," " Demonstration of First Field Dressing."

### B.—DURING ANNUAL TRAINING.

All ranks will be medically inspected as soon as possible after arrival in camp. Look out particularly for dirty skins, skin diseases, evidence of infectious disease or other illness. Do not forget those arriving for the second week.

On arrival the O.C. will give you a list of those (if any) who were reported temporarily unfit for training in the previous year. You will then decide whether they are fit for the present training.

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If there is no Camp Reception Hospital you will be allotted a tent for minor cases detained. No patient will be detained for more than forty-eight hours. If not fit to be discharged he will then be admitted to hospital.

Instruct your orderly that neither he nor anyone else is permitted to issue or administer any drugs or treatment (aperients not excepted) without the orders of the medical officer, with the exception that he may carry out preliminary cleansing or dressing of a wound or injury in the absence of the medical officer. In any case the orderly will direct the patient to attend before the medical officer at the next sick parade or earlier if necessary.

As soon as possible after arrival in camp inspect the medical history sheets of personnel employed in cook-houses. It is essential that no one who has suffered from typhoid, paratyphoid or dysentery, or is suffering from or under treatment for venereal disease, should be employed in the preparation, cooking or handling of food. The nominal roll which will be hung up in the cook-house (*see* Army Manual of Hygiene and Sanitation, 1934, Appendix 8, para. 2) will be initialled by you.

Do not tolerate slackness on sick parade. It is as much a parade as any other.

It is the duty of the orderly corporal to parade the sick and to complete Parts 1 and 2 of A.F.E. 550 (Sick Report) in duplicate.

As each patient is seen complete Parts 3 and 4 of A.F.E. 550. Return one copy to the Company or Battery, etc., Commander. Retain the duplicate for record purposes.

The Medical Inspection Book will be ruled with the following columns :  
Date, Army Number, Rank and Name, Coy., Nature of Disability, Treatment, Disposal.

The following classification will be used :—

DUTY (in red ink). Reported sick unnecessarily and disciplinary action should be taken.

M. & D. Treated to return to duty and need not report again.

ATTEND "A." Treated, to carry out all duties and report again.

ATTEND "B." Treated, to carry out light duty and report again.

ATTEND "C." Treated, excused all duties, and report again.

DETAINED. Detained in Camp Reception Hospital or tent for minor cases (not more than forty-eight hours).

HOSPITAL. Admitted to hospital.

All ranks reporting sick, whether actually attending the M.I. tent or not, will be shown in this book. Officers and warrant officers cannot be permitted to be "unofficially sick." The C.O. should be asked to order that all officers missing duty on account of sickness must report sick. Failure to insist on this may lead to the spread of disease.

The names of all personnel classified ATTEND "A," "B" or "C" will be rewritten on the list for each subsequent day until classified M. & D. or HOSPITAL. They should be seen daily. After each daily sick parade a line should be drawn below the last name, a summary made out and entered in the Medical and Sanitary Diary. Any special or urgent cases seen subsequently will be entered below the line and included in the following day's summary.

A return of sick will be submitted daily to the S.M.O. or, if there is no S.M.O., direct to the A.D.M.S.

On leaving camp at any time you will notify orderly room and your own orderly how long you expect to be absent, where you can be found, or how medical assistance can be obtained.

When any soldier reports sick his disposal is entirely in the hands of the M.O. It is desirable that the M.O., when ordering ATTEND "B" should satisfy himself that the man will be employed on duty suitable to his condition. Experience indicates that in most cases a man is fit to return to full duty earlier if he is taken off all duty at once and kept under close medical supervision than if he is ordered ATTEND "B."

Where there is a Camp Reception Hospital all cases for admission to hospital will be sent there. If any patient, in case of emergency, is sent direct to a military hospital, all particulars will be sent to the camp reception hospital so that the case may pass through the admission and discharge book. When there is no Camp Reception Hospital or medical unit the location of the nearest military hospital will be ascertained, and all cases for admission, other than emergencies, will be sent there daily immediately after sick parade. If there is no military hospital in the vicinity the location of the nearest civil hospital will be ascertained. But no patient will be sent there, except in emergency, without previous inquiry at the hospital as to whether he can be admitted. No patient will be sent to a civil hospital where payment is required unless the nearest military hospital is so far away that the journey is likely to be detrimental to the patient or suitable transport is not available. All cases sent to a camp reception, military or civil hospital will invariably be accompanied by a sick report carefully filled in. As a rule the name and location of the military or civil hospital to which patients will be sent will have been notified to you by the A.D.M.S. before Annual Training.

When a case is sent to a civil hospital the address of the next of kin should be given to the hospital authorities by the officer arranging admission with the request that, in the event of the patient becoming seriously or dangerously ill, a telegram be sent to the next-of-kin and the cost of the telegram recovered from the Command Paymaster.

When a patient is admitted direct to a hospital other than a military hospital you will report particulars of the case to the O.C. the hospital,

which normally receives the sick of the garrison, in order that the case may be recorded in the hospital A. and D. Book, etc.

In the case of any patient whose condition is such that, for his own welfare or that of his comrades, it is advisable that he should not remain in camp, he must be sent to hospital as quickly as possible. Any case suspected to be influenza or any other infectious disease, or requiring surgical treatment other than that of the most trivial kind, will be included in the above-mentioned category.

All ranks returning from hospital to duty should report to the M.O. at the next sick parade, and the O.C. unit should be requested to issue a standing order to that effect.

In the following cases a court of enquiry will be assembled as soon as possible, and, where practicable, on the day on which the disability is reported :—

- (a) If the disability is fatal (unless an inquest is held) or is certified by the M.O. to be of a serious nature.
- (b) In any case where a claim for compensation or pension is likely to arise.
- (c) In other cases where the C.O. considers it desirable.

The court will investigate and report the circumstances as affecting the question whether the disability was contracted in and by the performance of military duty. The court should record such opinion as they are able to form on this point. At camp the court will consist of a field officer, an officer of the rank of captain and an officer of the R.A.M.C. or R.A.M.C.(T.A.). If not required to give evidence at the inquiry the medical officer of the unit may serve. The report of the findings of the court will be in addition to the report on A.F.E. 550.

If the court considers the disability to have been caused in and by the performance of military duty, the M.O., on sending an officer or man home disabled, will give him a certificate stating : (1) Whether he is in need of further medical treatment, (2) whether he is incapacitated from following his trade or calling, and (3) the minimum probable further duration of the disability. If the case is in a civil hospital, the certificate of the hospital doctor will be accepted.

The M.O., on sending home an officer or man who requires further treatment and is not entitled to medical attendance under the National Health Insurance Act, will endeavour to ascertain whether treatment by a regular R.A.M.C. officer is possible, and, if it is available, will direct the officer or man to apply for such treatment.

You are the adviser to the O.C. unit on all sanitary and medical matters pertaining to the health of the unit, and as such will maintain close liaison with him. You will make such recommendations verbally or in writing, as you may consider necessary for the maintenance of the health of the

troops, and will forward copies of all important recommendations to the A.D.M.S.

The O.C. unit is responsible for the health of his unit and for the sanitation of his lines. You are his technical adviser without executive powers. You must advise as you think fit, but the O.C. decides on the action to be taken and accepts responsibility for his action. If the action taken differs from your advice you should make a written report to the S.M.O. or A.D.M.S. (if there is no S.M.O.), forwarding a copy to the O.C. unit.

Any hygienic defects found and the recommendations made to the O.C. will be recorded in a Sanitary Diary, which will be passed to the O.C. concerned, who, after recording in it the action taken, will return it to you. Should the defects not be remedied within reasonable time, or should you consider further action necessary, you will, without delay, report the matter to the A.D.M.S., sending a copy of your report to the O.C. unit. The pages of the Sanitary Diary should be ruled in three columns to show : (1) Medical Officer's remarks; (2) Commanding Officer's remarks; (3) Action taken. It is essential that action taken should be recorded. It is essential for the efficient working of the medical services that all matters other than those of a trivial nature, which can be put right at once, should be reported in the Diary. Reports and recommendations given verbally must be repeated in writing in the next report.

The Diary should also contain a note of any skin or other inspection carried out, stating the company or unit inspected. It should also contain a note of any lecture or other instruction given by the M.O.

The cleanliness of cookhouses and their grease traps is the responsibility of the cooks and not of the pioneers or sanitary personnel.

If necessary, recommend that containers for latrine paper be provided.

Disinfectants are distributed in five-gallon drums. Indents should be countersigned by the M.O. and should be sent in twenty-four hours before the articles are required.

The Appendix to these notes will help you in suggesting what to look for in your daily inspection.

In case of doubt or difficulty as regards sanitary measures, the advice of the Divisional Hygiene Section should be obtained.

You are responsible for the training of stretcher-bearers, first-aid and sanitary and water duty personnel of the unit to which you are attached.

Make yourself aware of what training the unit is carrying out. Whenever the unit takes part in a tactical exercise, apply to have the stretcher-bearers attached to you and establish a Regimental Aid Post with the means at your disposal.

Inspect the menu each week in consultation with the messing officer.

You will ascertain that articles of food and drink supplied to the troops

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are of good quality and that the amount, cooking, variety, preparation and storage of food are satisfactory. You will see that overcooking is not practised so as to destroy vitamins.

You should frequently inspect the method of sterilization of drinking vessels and eating utensils in all canteens, etc.

You should satisfy yourself that the amount, quality, and arrangements for distribution of drinking water are satisfactory.

Report forthwith to the A.D.M.S. any occurrence of an unusual outbreak of sickness or infectious disease.

If necessary, recommend the improvization of a drying tent.

See that the water carts are working properly.

Keep an eye on the clothing of the unit, paying particular attention to the boots and socks.

Presence at bathing parades will help you to judge as to the personal cleanliness of the personnel.

All ranks should be warned of the danger of applying a greasy dressing to parts affected by sunburn. A soothing lotion, e.g. *Lotio Calaminæ*, should be indented for prior to camp and all ranks encouraged to use it.

Urgent medical supplies can be obtained from the Camp Reception Hospital or the nearest military hospital. In extreme emergency purchases may be made from a local pharmacist. M.O.s so purchasing will at once apply for covering authority to the A.D.M.S. stating fully the grounds for urgency. The bills will be sent to the A.D.M.S. for approval of the D.D.M.S. and settlement by the Command Paymaster.

The time and date of the A.D.M.S.'s camp inspection will be notified to units in advance of annual training. At this inspection the M.O. of the unit will always be present accompanied by a commissioned representative of the unit, usually the Quartermaster, and the senior sanitary orderly. The Sanitary Diary and the Medical Inspection Book will be produced for the A.D.M.S. to see.

#### C.—AFTER ANNUAL TRAINING.

Prepare your Sanitary Report in duplicate and forward to the S.M.O. or (if there is no S.M.O.), the A.D.M.S. (Regulations for the Medical Services of the Army, 1932, Appendix I, will help you).

#### APPENDIX.

##### POINTS TO BE NOTED ON DAILY INSPECTION.

**LATRINES.**—Type, number of seats (5 per cent with addition for serjeants), cover, disposal of excreta, fly-proof, self-closing, cresol, supply of paper, containers for paper, lighting after dark, general cleanliness, fouling of ground.

**URINALS.**—Type, number, disinfectant, lighting after dark, general

cleanliness, fouling of ground, prevention of refuse entering pipe, condition of soak pit, night urinals.

**COOKHOUSES.**—Type, general cleanliness, preparation table, chopping bench, cleanliness and adequacy of utensils, washing-up bench, grease trap, soak pit, covered refuse and swill tubs, disposal of refuse and swill, personal cleanliness of employed personnel, clothing, washing arrangements, nail brushes, soap and towels.

**ABLUTION PLACES.**—Type, extent of accommodation, general cleanliness, fouling of ground, grease trap, soak pit.

**SHOWER BATHS.**—Type, general cleanliness, grease traps, soak pits, fouling of ground.

**DINING TENTS.**—System of messing, adequacy of accommodation, arrangements for service, arrangements for washing-up, general cleanliness, cleanliness of table tops (and under surfaces), cleanliness of forms, no food to be kept in tents, personal cleanliness of orderlies and their clothes.

**LINES.**—General cleanliness, refuse receptacles (covered, regular emptying), looping up of tent flies, floors of tents.

**CANTEENS AND MESSES.**—General cleanliness, washing-up arrangements, sterilizing of glasses, crockery and cutlery, storage of food.

**FOOD STORES.**—Type, adequacy, general cleanliness, ventilation, fly-proof, temperature, dampness, provision of muslin.

**INCINERATORS.**—Type, adequacy, position, efficiency, cleanliness of surrounding ground.

**LAY-OUT OF CAMP.**—General consideration, slope of ground, prevailing wind, sanitary area, messing area.

[The writer is indebted to Colonel J. P. Clarke, T.D., Assistant Director of Medical Services, 55th (W. Lancs.) Division, T.A., for permission to submit this article for publication.]





## Editorial.

### UNDULANT FEVER.

INVESTIGATIONS on undulant fever in France by R. M. Taylor, M. Lisbonne, L. F. Vidal, and R. H. Hazemann were begun in 1931, and a preliminary report and articles on the studies have been published in French papers. Since these publications the data have been amplified and the salient features of the studies are considered in an article in Vol. VII, Extract No. 9, of the *Bulletin of the Health Organization of the League of Nations*.

It is pointed out that the epidemiology of undulant fever is exceedingly complex. We know that the organism may be excreted through milk, urine, abortion products, and vaginal discharges. The disease may be contracted by ingestion and the authors state that the organism possesses the ability to enter the body easily through the skin or mucosa of the nose and eye. A wide range of domestic animals may be infected and there are three varieties of *Brucella* having wide differences of pathogenic selectivity. The source and manner of infection in different countries may show wide divergencies, and the authors say it should be borne in mind that their studies deal with the disease as it occurs in France and the inferences they have drawn need not necessarily apply elsewhere.

France is, for the most part, a country of agricultural and animal husbandry; domestic animals are widely distributed; but as the farms are usually small the herds and flocks are not large. There are, however, regional exceptions to this general statement. In the departments bordering on, or near, the Mediterranean, cattle are scarce and most of the domestic animals consist of sheep and goats. In the south-east and south-west departments there is the custom of gathering together flocks of sheep in the lowlands adjacent to the sea and herding them in high mountain pastures during the summer. The assembled flocks may number several thousand animals. In the autumn they are re-distributed to their respective owners. Also in villages situated in the mountain valleys there is customarily a village shepherd who is responsible for grazing all the sheep and goats of the village; there is consequently a daily intermingling of all the small flocks of each village.

Raw milk is not frequently partaken of in France as compared with Germany, England, Holland, the Scandinavian countries and the United States; nor is fresh unfermented cheese extensively eaten.

On the other hand the contact of the rural population with their animals is exceedingly intimate. On the smaller farms the stable is part of the house; and in the larger farms the buildings including the residence

are built in the form of a quadrangle and the enclosed space forms an area in which the animals circulate.

Owing to the laxity in reporting cases of communicable disease, it is impossible to give an accurate statement of the number of cases of undulant fever which actually occur; but from various sources of information the authors state that though a few cases have been diagnosed in many of the departments of the north, centre, and west, the disease is comparatively rare in these regions and only occurs in a few isolated and widely separated cases. In contrast, the disease is endemic in the south-east and south-west and may reach epidemic proportions over a year or so.

Another feature of its distribution, which applies to the country as a whole, is that it affects almost exclusively the rural population. When cases develop in the larger towns or cities, they occur almost invariably in persons who have been associated with the transportation or slaughtering of animals, particularly sheep and goats.

There exist differences of opinion as regards the classification of the *Brucella* strains: whether the different types are to be considered as true species or merely as varieties of this same species. Dr. Taylor and his co-workers used the terms *melitensis*, *abortus* and *suis* to designate respectively caprine, bovine and swine types. During their studies they isolated from man and animals 817 strains and received 52 strains from the State Veterinary Laboratory at Alfort. The strains were classified by the determination of the bacteriostatic action of thionin and basic fuchsin, the production of  $H_2S$ , and  $CO_2$  requirements on primary culture. The discoloration of fuchsin aided the diagnosis of *melitensis* as none of the others had this effect. Of the 869 strains examined 843, or 97 per cent, fall into one of two types—*melitensis* or *abortus*; that is they either grew well on both thionin and fuchsin media and produced no  $H_2S$  (*melitensis*); or they were inhibited by thionin and produced  $H_2S$  in considerable quantities for two or more days (*abortus*). No strains having the characteristics of *suis* were encountered.

The animal strains classed as *melitensis* predominated in the regions where undulant fever is frequent and endemic, and *abortus* rare and sporadic. The strains reacting as *abortus* were recovered from cows and horses, while the strains from goats and, with one exception, all those from sheep were *melitensis*.

Epidemiological investigations showed that all the human strains typed as *abortus* were traceable to infection from cows, and where the human infection appeared to be traceable to sheep or goats the strain isolated was typed as *melitensis*.

These main features correspond to what one would expect; *melitensis* is found extensively in sheep and goats and in the localities where this type occurs undulant fever is frequent. The *abortus* is associated with infection of cows and horses, and where it predominates human infections are rare.

Dr. Taylor gives an interesting table from which it appears that in the south-east 119 human strains of *melitensis* were isolated and only one of *abortus*, and in the south-west 294 strains of *melitensis* and 3 of *abortus*; in both these departments undulant fever was prevalent. In the east there were 57 human strains of *melitensis* and 22 of *abortus*; here 31 strains of *melitensis* and 44 of *abortus* were obtained from cows and undulant fever was frequent with epidemic foci.

Six out of seven strains of *melitensis* recovered in the north were isolated from personnel of the Paris abattoir who were engaged in handling or slaughtering sheep. As sheep in this abattoir are received from all parts of France these cases cannot strictly speaking be regarded as indigenous in origin. The seventh strain of *melitensis* from the north was recovered from a ewe in a large flock of 250 sheep which had been purchased from a stock-dealer; it is not unlikely that some of the animals may have come from localities in the east, where *melitensis* infection had been demonstrated. The seventh strain was isolated from the milk of the ewe, and it was found that three cases of undulant fever had developed in the family of the owner of the flock.

The number of strains (64) recovered from cows and classed as *melitensis* is remarkable. These strains were found only in the *melitensis* zone and *melitensis* was known to exist in the community from which they came and with few exceptions there was direct contact of the cows with infected sheep or goats. In every instance where *melitensis* was recovered from a cow there were associated cases of undulant fever. On the other hand *abortus* infection of cows is widespread, yet the number of cases of secondary human infection is comparatively small.

A striking difference between the *abortus* and *melitensis* infections of man was that the former were scattered and isolated and the latter were bunched and several cases in one family were common.

Attention was first focused upon personal investigation of cases reported from all parts of the country, but it soon became evident that in the majority it was impossible to determine definitely the source of infection. It was common to find that the person had been in contact with several species of animals and had sometimes consumed milk and cheese from more than one source.

It was therefore decided to select certain communes where the disease was prevalent and survey the entire population with the object of ascertaining any differences in the habits and environment of the persons who had contracted undulant fever and those who had escaped. The accuracy of the diagnosis was believed to be great as the physicians in charge had much experience of the disease. Moreover 200 intradermal tests were performed and it was found that all the persons who had been diagnosed undulant fever gave a positive reaction to *Brucella* protein.

These surveys, involving a population of 4,315 among whom 496 cases of undulant fever had been diagnosed, were made in the south-west of France and all the strains isolated from man and animals were classed as *melitensis*. Sheep and goats were the predominating domestic animals and constituted the principal, if not the sole, reservoir of infection.

There is a marked seasonal variation. The lowest number of cases occurs during the summer followed by a gradual rise, reaching a peak in March. 70 per cent of the cases occur from December to May, and 50 per cent in the months of February, March and April. The spring incidence is most marked among cases attributable to goats and sheep.

Of the 496 cases discovered during the communal surveys 67·9 per cent occurred among males and 32·1 per cent among females. Below the age of puberty there is little difference between the two sexes, but thereafter the infection rate in males is twice as high as in females. Contact with sheep and goats and the handling of their excreta formed the main source of infection and men were thus somewhat more exposed; but the attack rate among females when similarly exposed was only about half that of the males; this suggests that after puberty women are relatively resistant to clinical attacks of undulant fever.

It also appears that children enjoy a certain immunity, as in these villages the stable as a rule is part of the house and apparently the exposure of children is as great as that of the adults.

In the communes where the entire population was surveyed, sheep and goats were the predominating domestic animals, and all evidence pointed to them as the principal reservoir of disease. Goats and sheep, either separately or in combination, accounted for 45·5 per cent of the cases; cows alone for 15 per cent, and cows in combination with goats and sheep for another 25·8 per cent.

The rôle of the hog as a source of infection was kept in mind, but with the exception of one commune where there appeared to be some connexion between undulant fever and this animal, nothing was discovered to incriminate it. As the hog under suspicion had been slaughtered no laboratory tests could be made. As *melitensis* was the only type isolated in this commune, attempts were made to test the susceptibility of hogs to this type. None of the artificially infected experimental animals developed positive agglutinins or gave an intradermal reaction; *Brucella* could not be isolated at autopsy. Inquiries at large abattoirs failed to elicit a history of undulant fever from any of the personnel engaged in slaughtering hogs; while the disease was common among the butchers of sheep and goats. No strain among the 869 examined possessed the cultural characteristics of the *suis* type.

When cows become infected with *melitensis* they appear to produce as many cases as goats and sheep. The organism, like *abortus*, tends to

persist in the udder. In five out of nine cows the organism was still being excreted some two years after it was first discovered and still maintained the characters of *melitensis*. It is estimated that two-thirds of the cases originating from cows are of this type. Epidemiological and laboratory studies suggest that sheep tend to recover from the infection and that sheep and goats are most dangerous in transmitting the disease during, or shortly following, abortion.

As regards the manner of human infection, it is interesting to note that the number of persons consuming *raw* milk and fresh cheese was the same in two groups, consisting of those who had and those who had not contracted the disease. But the proportion of individuals having habitual contact with sheep and goats was very significantly higher in the group that contracted the disease than in the group that escaped.

There is also a good deal of circumstantial evidence indicating that infection through contact is much more frequent than infection through food.

Taylor and Hazemann state that water supplies and other sanitary conditions have little correlation with the causation of undulant fever. They write that in several cases individually investigated, infection by water was suspected, but they believe this to be relatively rare and of little importance.

They consider that the importance of contact infection should be fully recognized as it presents quite a different control problem. Through boiling or pasteurization, transmission of the disease by milk may be arrested. But for those whose occupation brings them into contact with animals or their carcasses, no such simple means of prevention is at hand. Their unsuccessful attempts to protect animals by killed vaccines and the occurrence of seven cases of undulant fever among the personnel associated with the investigation, all of whom had received prophylactic vaccination, leaves them with little faith in protecting man by this measure. The greatest hope lies in the control of the disease in animals.

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## Clinical and other Notes.

### TREATMENT OF SPRAINS OF THE BACK BY MANIPULATION.

BY MAJOR S. J. L. LINDEMAN, M.C.,  
*Royal Army Medical Corps.*

THERE is a tendency amongst the medical profession to look with great disfavour on any mention of the word "manipulation." To many it is like a red rag to a bull, and conjures up a picture of the most blatant quackery and unqualified roguery.

This is a pity when such excellent results can be obtained in certain classes of case by very simple procedures. It is our failure to cure these cases which drives patients to the osteopath or unqualified manipulator who undoubtedly does cure them, and on his success he is apt to base his fantastic claim to deal with many other different conditions.

Manipulative surgery is, of course, practised by the orthopædic surgeon for a great variety of joint and other conditions, but the class of case which can always be benefited and generally cured often dramatically by manipulation is an injury of the muscles of the back, popularly labelled "lumbago." This is a very common condition and one which any of us should be able to deal with unaided.

One of the chief reasons that have been alleged against manipulation is that the manipulator cannot give on every occasion a satisfactory pathological explanation of the condition he is treating nor say exactly what he has done to cure it.

This is a fallacious objection as any treatment which proves successful must surely be adopted even if we may not be able to explain exactly how it works.

On going into the history of these cases it will generally be found that the pain and stiffness came on either extremely suddenly or more gradually after some sudden jerky movement under some condition of strain. Such movements as digging in the garden, lifting a heavy box, swinging a side of meat, diving from a height, slipping on a mat or swinging a golf club or getting up quickly from a deep chair are all associated by patients with the onset of their trouble. All these movements involve more or less sudden combined bending and twisting movements which probably catch some of the muscle fibres of the erector spinæ unawares so that they become if not actually caught up on some bony point at any rate out of alignment so that any further attempted movement causes pain. The

condition is therefore in the nature of an injury, and it appears that it might be compared to a link of a bicycle chain slipping off a cog.

It occurs most commonly in the lower dorsal and lumbar region and it is invariably called "lumbago." This is a suitable enough name in so far as it means a pain in the back but most unfortunate in its suggestion of inflammation, rheumatism and popular pills.

On examination of the patient the pain may be referred across both sides of the spine and more usually one side is worse than the other. There may or may not be a definitely tender spot. There is always some, often very marked, limitation of flexion and extension of the spine. The patient cannot bend down to his toes or if he gets down cannot spring up. In the more acute cases he may be unable to get up at all and may lie curled up in bed in agony at the slightest attempted movement.

The usual treatment of these cases in the past has been lengthy, varied and most unsatisfactory. Some have had heat, some cold applied; radiant heat, electricity, massage, liniments, salts, salicylates and aspirin are popular. Many have been put on strict diets denying them all the good things of life in the way of food and drink. Some have had all their teeth removed, others have suffered copious colon ~~lavage~~ or various spa treatments.

The cases described below were all treated by manipulation only and in no case was an anæsthetic given. Before doing any manipulation it is obviously essential to exclude, by X-rays if necessary, any bone disease of the vertebræ or pelvis.

The procedure in each case was to go into the history carefully, then examine the patient stripped, and then carry out the series of routine manipulations.

The routine manipulations are as follows :—

(1) Patient lies at ease on his right side, arms forward, elbows in front of the face and knees well drawn up. The operator stands behind the patient and places his hands firmly on the left shoulder and left ileum of the patient. The patient is instructed to let himself go quite slack, and this is essential, otherwise the manipulations cannot be carried out.

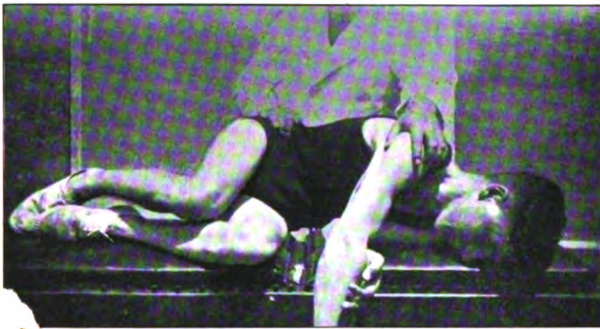
The operator then sharply and forcibly pushes the shoulder forwards and pulls the pelvis backwards, then reverses the process by pushing the pelvis forwards and pulling the shoulder backwards. This is repeated several times in both directions.

(2) The patient turns over on to the left side and the same process is repeated on that side.

(3) The patient lies on his face. The operator places one hand under the patient's thighs just above the knees and raises the pelvis up and down from the bed, at the same time making counter-pressure downwards with the other hand on the lumbar spine.

(4) The patient is stood to attention and is told to reach his leg sideways as far as he can with the tips of his fingers on each side in turn. He is assisted to reach a little further by the operator gently jerking his head and the opposite shoulder in the required direction.

(5) The patient lies on the ground on his back, hands down just away from the side. One end of a roller towel is placed under the lumbar region. The operator stands across the patient at the same level and places the other end of the roller towel round his own neck. The operator



First and second manipulation, first phase. Shoulder forward, pelvis back.



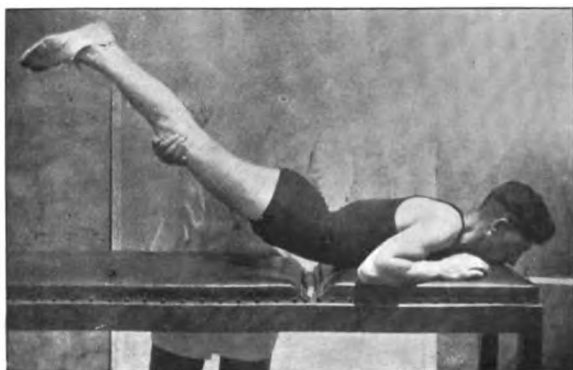
First and second manipulation, second phase. Shoulder back, pelvis forward.

takes hold of the sides of the towel low down and slowly and deliberately lifts the patient off the ground as high as he will go, then gently lowers him again. This is repeated six to ten times. It is essential that the patient should let himself go absolutely slack and not resist or attempt to help the movement.

The patient now almost invariably jumps up with surprising agility and says that he feels much better and looser in every way and often practically cured.

Examples: (1) Private ——. Diagnosed acute lumbago, sudden onset lifting a bucket of water two days previously. Lying curled up in





**Third manipulation.**



**Fourth manipulation.**



**Fifth manipulation.**

bed, complains of severe pain, unable to get out of bed by himself and cannot stand up straight. Routine manipulations were carried out. He got straight up from the floor and said he was much better, he could move freely in all directions and stand quite straight. Manipulation repeated the next day when only a slight stiffness remained. Discharged to duty on the fourth day; no recurrence.

(2) Mr. ——. Said he was subject to lumbago and had had an acute attack three weeks before while playing tennis in the act of serving. Was very depressed as he was threatened by his doctor with a low diet and nothing to drink. Rather dubiously said he would try manipulation. Routine treatment followed by immediate relief of pain and free movements. Beyond slight stiffness he had no further trouble. Manipulations were repeated on the third day and he was playing tennis again within a week.

(3) Lance-Corporal ——. Sent into hospital from an out-station as chronic lumbago of one month's duration. It had come on suddenly as he was swinging a side of meat in the Quartermaster's Stores. Walked slowly with a stoop. Extremely stiff and unable to bend down or stand up straight. X-ray showed no boney injury. Routine manipulations were carried out gently and followed by immediate improvement. Manipulation repeated more vigorously next day with further improvement. After the third manipulation he was cured and returned to duty.

(4) Captain ——. Complained of chronic lumbago of five months' duration. He was unable to play polo. Did not remember a definite injury but the lumbago came on after playing polo. He had pain across the lumbar spine. After routine manipulation he felt looser and was told to return if it had done him any good. Returned after four days, said he was much better and asked for more manipulation, proposing to re-start polo at once.

(5) Private ——. Diving from a high dive came down a bit awkwardly and as he hit the water got a sudden severe pain across the lumbar spine. Had difficulty in getting out of the water and could neither bend down nor stand up properly; walked with difficulty, bent up. Admitted to hospital next day and manipulated with immediate great improvement and relief of pain. Manipulation repeated on two successive days and discharged recovered the following day.

(6) Private ——. Employed in the stores. Was lifting heavy boxes in the morning and in the afternoon had sharp pain across lumbar region. Walked stiffly and could not bend. Manipulated with immediate improvement. Manipulation repeated on two successive days when he was cured.

(7) Serjeant ——. Had had some stiffness of the back for three weeks. The day before admission suddenly had acute pain across the lumbar

region on getting up from a deep chair out in camp. Was unable to stand up and had to be carried to bed. Sent into hospital on a stretcher, and it required three people to get him off the stretcher on to a mattress on the floor, as he could not stand on his feet at all. Routine manipulations were carried out at the end of which he got up without assistance, dressed himself, including putting on his socks and walked off to his quarters. He said it was miraculous and he would not have believed it possible; the pain was entirely relieved and only some stiffness remained on certain movements. After the third treatment, he was completely recovered and required no further treatment.

(8) Miss ——. A nurse, stepped into a small hole in the ground playing hockey and thought she had torn a muscle in her back. Very stiff and unable to bend down or straighten. Manipulation was followed by immediate great improvement and she could at once bend down and touch the floor. Improvement was maintained and further treatment not required.

(9) Serjeant-Major ——. A fine, soldierly figure. Complained of pain and stiffness of the lumbar spine of gradual onset. He found it a nuisance as he could not bend, turn round quickly, or stand to attention properly. Manipulation was followed by immediate relief. When seen a few days later he said it had been unnecessary to return for more treatment as he had been completely cured and was now perfectly fit.

(10) Lieutenant ——. First felt pain and stiffness across the upper lumbar spine on getting out of bed about three weeks before. Could not touch his toes and had had to stop playing polo. There was immediate improvement after manipulation. Returned next day saying he was much better and asking for more. It was repeated; he played polo that afternoon and had no further trouble.

(11) Mrs. ——. Sent into hospital on a stretcher as acute lumbago. A big heavy woman with great pain and stiffness. No history of injury. Cured by two manipulations and discharged from hospital the third day. One month later there was no recurrence and she was perfectly well.

(12) Commander ——. Complained of lumbago of eight months duration. While grouse shooting in Scotland, he slipped on a stone and had sudden pain in the lumbar region which had been there ever since. During routine manipulations said he felt something give way and the pain was immediately relieved. On inquiry several times in the next six months he said he was very much better, had had no more pain but was still occasionally stiff.

There is no doubt that all these patients were perfectly genuine and the pain and disability complained of actually existed. One occasionally comes across malingerers who complain of similar symptoms which are well known to everyone and may be hard to disprove. In such cases as

there is no actual disability they either deliberately resist or will not admit any improvement from manipulation and this in itself tends to confirm the suspicions of them.

No originality is claimed for this method of treatment ; but the cases are recorded to draw attention to a simple and effective form of treatment for a common condition which seems to be but little known or practised at the present time.

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### MOUNTAIN STRETCHER.

By G. A. PARK ROSS, M.D., D.P.H.

*Deputy Chief Health Officer, Union of South Africa.*

THE apparatus described has been in use at the Natal National Park for three years.

During this time seven major accidents, including four compound fractures of the leg, and multiple injuries, together with minor mishaps, have been handled on the apparatus and mainly without professional directions. Most of these accidents occurred at a height of 5,000 feet above the Hostel, and at an average distance of twelve to fourteen miles from it. Part of there turn journey has usually been made by a rough track, but even when this could be followed, bearers using the stretcher on its carriage prefer to leave the track and take short cuts down the steepest hillsides. This is practicable so long as the terrain is not too steep to stand on without support, and is preferred by the patients as the roughness of the country makes little difference to them.

#### DESCRIPTION.

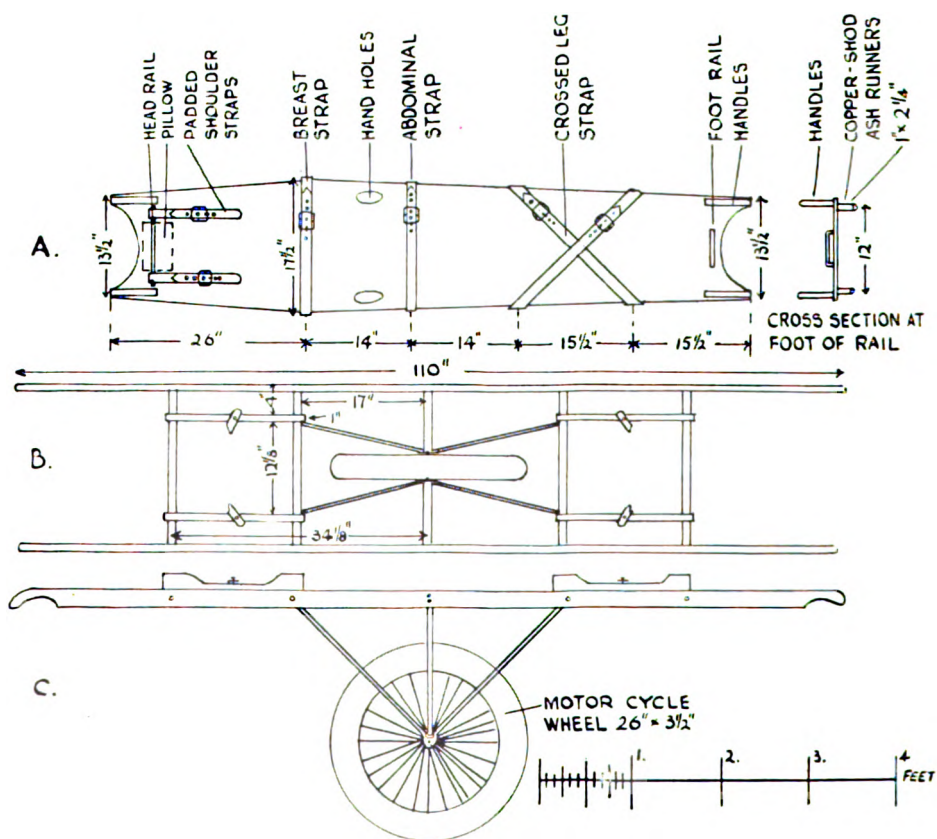
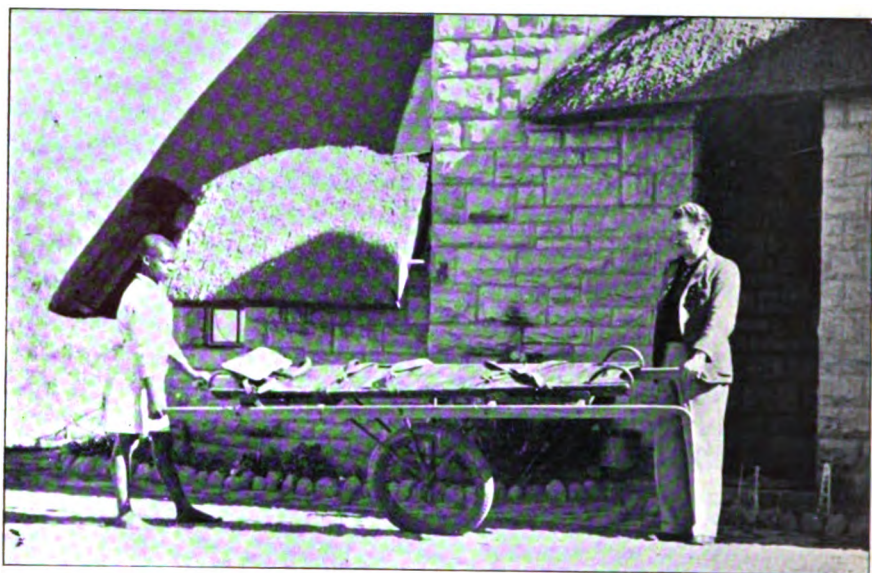
The contrivance consists of a stretcher and a carriage. The former is a modification of that used on the Rand Mines. The latter is modelled on the bush machila used in Central Africa, and I had already introduced a modification of it for carrying disabled lepers over the steep mountain tracks of Zululand.

The details are shown in the photograph and scale diagrams.

*The Stretcher* is made of  $\frac{3}{4}$  inch philippine mahogany laid on the cross and screwed to runners of ash,  $2\frac{1}{4}$  by 1 inches. These are shod with copper. The leather straps are  $1\frac{1}{2}$  inches wide. Their position is most important and is indicated on diagram A. The shoulder straps are padded and threaded through the head rail. A long perineal strap passed through the same rail is recommended on the Mines, but we have not used ours and have not shown it on either diagram or photograph.

*Operation.*—Remove the stretcher from the frame.

To get extension in leg fractures use the body weight by raising the foot end of the stretcher and tying the foot or ankle to the foot rail.



Apply splints if desired, tie the legs together, wrap in eiderdown, affix leg and shoulder straps and pull tightly (patients always prefer this). Then pad up with blankets and fix body straps, tying arms in if desired.

Apply perineal strap if desired. Our patients have usually objected to it.

For head injuries, high handles would be an advantage, and would allow of the stretcher rolling right over without damage to the face. Our handles are lower, as shown, and are made of light copper tubing screwed to runners.

It is advisable to attach to the stretcher a set of instructions for dealing with spinal injury. We use the set got out for the Rand Mines.

When properly fixed it makes no difference to injuries whether the patient is turned upside down or face downwards, and in coming down steep places persons with leg injury usually prefer to be brought down head first.

The carriage requires little description as the details are shown in the diagram. It is made of ash. The wheel is a standard motor bicycle one and its centre is 20 inches below the top of the rail. The middle support bars are 1 inch steel tubing, the four side bars  $\frac{3}{4}$  inch steel tubing; these are riveted to a small plate in which the wheel axle is inserted into holes, not slots, as is the practice on bicycle front forks.

*Instructions for Use.*—Hold the carrier horizontally and place the stretcher on top with runners between the guides. Lock the clamps and tighten them with a small spanner carried on the stretcher, if the trip is a long one.

When carrying the stretcher by hand six persons are advisable. When using the carrier on steep places it is best to have six on the stretcher and another six on one tail rope (two ropes are unnecessary). An extra safety line round the patient and under his arms gives him a feeling of confidence on very steep places.

On rough ground the stretcher does not get bumped at all as carriers follow the contour of the ground automatically, and the wheel only touches the high spots. On smoother ground the wheel takes the whole weight, and in places bearers can run, but, as stated, six carriers are essential. A fast walking or climbing pace can be maintained without the unendurable fatigue incidental to stretcher carrying by hand.

Except on slopes too steep to move over without using hands, it is always preferable to use the carrier complete.

Patients, well padded up with eiderdowns, invariably state that they are more comfortable on the stretcher and carriage than they are while awaiting transport, and no morphia has been used for the last six fractures, three of which were compound.

## Echoes of the Past.

### "BATS IN THE BELFRY."

BY LIEUTENANT-COLONEL J. E. M. BOYD, M.C., F.R.E.S.,  
*Royal Army Medical Corps (Ret.).*

IN the year 1910 I did duty at the British Station Hospital, Dalhousie, Punjab, as a Lieutenant, R.A.M.C.; in November, 1930, I returned as Officer Commanding the British Military Hospital, the same group of buildings, as a Major.

The hospital consisted of two main blocks with the usual out-buildings, Indian Hospital Corps lines—cookhouses and other annexes—a small section of an Indian Military Hospital, and on an adjoining hill the isolation section and dental centre. Except that the upper story had been removed from one of the blocks owing to a local landslide rendering the building too heavy for its foundations, there was little change in the general appearance between 1910 and 1930. One innovation, however, to which I took strong exception was the presence of the District Laboratory in the main block, sandwiched between the "skin" and "detained" wards—a most insanitary arrangement which has, I am told, since been remedied.

In 1910 there were complaints of bugs in the wards, but as in those days I was not particularly interested in entomology, beyond the slaughter of inoffensive butterflies and moths—which abound in large variety—and also the insignificant position which I held prevented my taking any action in the matter, so having reported the presence of the bugs I retired into the obscurity of my menial position.

In 1931 the state of affairs was much altered as far as I was concerned, so when complaints regarding bugs in the wards were brought to my office I, in my exalted position as Officer Commanding, had to take notice. I asked for specimens, which were soon forthcoming from the upper floor of the main block, few, if any, being found on the lower floor.

The upper floor comprised the surgical ward, next the operating theatre, the medical ward, dysentery ward, officers' recreation room, officers' ward and, as far as I can remember after all these years, a second officers' ward with the usual annexes and bunks.

During the winter months this block had been empty and no bugs had been found during the frequent sweeping and cleaning of the wards, but as soon as the block was in use after the arrival of the troops from the plains the bugs appeared.

Something had to be done; fumigation proved useless, scores of bugs

were caught and destroyed, but eventually bugs became a sort of nightmare to all members of the hospital staff. Examination showed that the bugs did not belong to the common species of the northern latitudes, *Cimex lectularius*, nor its tropical brother, *C. rotundatus*, but that they were uncouth hairy creatures with long narrow bodies: a human host was accordingly eliminated. *C. pipistrelli* seemed to suggest itself—were bats to be found? They were present in hundreds living in all cracks and crevices and under the roofs of all buildings, causing a musty odour which was very noticeable at times, but only on the upper floor.

The M.E. Service was approached with a view to the removal of the bats and closing of the holes in which they rested; there was much discussion on the subject which continued until the nights became colder and the bats, like the majority of other living creatures, retired to the warmer climate in the plains. The most enjoyable winters we had in India were spent at Dalhousie, the only drawback being the lack of sport—leopards are the only game available, and these are rapidly decreasing as the number of Indians with guns increases.

Someone, unknown to me, engaged two experts in bat catching from Chamba State. I never saw the result of their efforts, and it is very doubtful whether they caught any bats at all—probably they were rat catchers.

The early months of 1932 opened peacefully, only the family hospital in the lower block was open, but as the temperature gradually rose up came the district and brigade staffs, the troops, followers and the bats.

The wards in the main hospital opened, and soon after the complaints regarding the presence of bugs began.

The Sisters complained that there were bugs in the men's beds—as the bugs did not bite the patients there were no complaints from the men; the presence of bugs being looked upon as normal in many of the barracks in India.

The surgical specialist complained that bugs fell on him and his victims from the ceiling during operations; bugs were to be seen in the operating theatre, crawling over the dressing trays—drowning in the lotions and climbing on the walls.

In the officers' ward conditions were even worse, and it became necessary to use mosquito nets to protect the patients. At the time we had a rather dictatorial Brigadier—a charming old man really, but one who liked to appear impressive. He was one day visiting the officer commanding one of the units stationed at Dalhousie, who was a patient in hospital, safely enclosed in a mosquito net. In due course bugs began to fall and some of these were spotted by the Brigadier. He at once asked the patient why he did not make an official complaint on the matter; the



patient replied that he saw no reason for doing so, as the hospital authorities were doing all they could.

Correspondence started some little time later with the Brigade authorities and tended to become personal, and eventually I had to tell one of the numerous members of the staff who persisted in worrying me that I did not consider that it was part of the duty of a Lieutenant-Colonel, R.A.M.C., to which rank I had been promoted some months before, to climb about the rafters of a building to hunt either bats or bugs.

This state of affairs had already been reported to higher authority, who were dealing with it with the usual speed one associates with all matters of importance in India, and so finally the M.E.S. workmen came down and blocked up a few of the larger holes—but they could not deal with the smaller cracks and holes through which the bats entered.

The climax was reached when the Divisional G.S.O.1. was admitted to hospital; for when a bug fell on the bed of so exalted an officer trouble began, and efforts were really made to do something.

In the meanwhile I sent to the bazaar for some Cantonment sweepers, told them to get up under the roof and collect as many bats as they could—offering one rupee a hundred for the corpses; in less than an hour the men came down and emptied sacks of dead bats at my feet—these were counted and numbered over 1,500—so I had to amend my offer by saying that there was a ten-rupee limit.

Examination of the bats showed the presence of a few bugs and innumerable mites: specimens of both were sent home to the British Museum Natural History, South Kensington, for identification; unfortunately the specimens of bugs were damaged on the way home and I had left the Station before I received a request for more specimens. The opinion was expressed that they were not *C. pipestrelli* but a species, possibly new, rather like it.

The Divisional Headquarters block was also infested, so one Sunday a “gas cloud” was released under the roof, and later about five hundred dead bats were found; a day or so later I received a letter asking me if the parasites from the bats would have any ill-effects on officers and clerks working in the building.

As, at the time, I was officiating as A.D.M.S. I was able to reply that beyond keeping them awake I did not think that there would be any ill-effects. This ended the correspondence.

Since leaving Dalhousie I have heard that funds were made available for bat-proofing the buildings, and that the plague of bugs has ceased.

I tried to get further specimens of the bugs, but failed; but perhaps someone doing duty in Dalhousie might be able to get some, as there are many infested buildings in the station. If any are obtained they should

be sent to the British Museum Natural History, Cromwell Road, South Kensington, where they will be greatly appreciated by the experts, especially if they turn out to be a new species. Dry specimens are preferable, and the packet should be marked on the outside, "Entomological Specimens. Not to be opened by Customs."

When sending specimens it should be assured that they are members of the *Cimex* family, as I was rather surprised, just before leaving India, when a junior officer, on being shown a bug in a test tube, said, "Is that a bug, Sir? I have never seen one before; may I take it home to show to my wife?"

There were some good slides of *C. lectularius* at the College, which I mounted for the Hygiene Department some years ago. *Verb. sap.!*

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### Current Literature.

ADEY, C. W. **Certain Modern Agents for the Detection and Abolition of Susceptibility to Diphtheria.** *M. J. Australia*. 1938, v. 1, 47-52. [27 refs.]

This is a useful critical review of the present position of alum-precipitated toxoid as an antidiphtheria prophylactic. The literature is conveniently reviewed in the form of tables giving the results of various workers as regards immunizing results, duration of immunity and undesirable reactions. It is concluded that alum-precipitated toxoid administered in one dose only is unsatisfactory as an immunizing reagent and may occasionally cause severe general and local reactions. The most suitable prophylactic both for large-scale campaigns and for the immunization of individuals and small groups is considered to be ordinary toxoid. C. C. OKELL.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

LORENTZEN, G. & EWERS, G. Ueber eine Scharlachepidemie durch Milch. [A Milk Epidemic of Scarlet Fever.] *Offentl. Gesundh.-Dienst*. 1938, v. 4, A. 1-10, 3 figs.

A very clearly written account of an epidemic of scarlet fever in the town and district of Pinneberg (a town of 11,000 inhabitants, near Hamburg). In the epidemic itself, which began in April, 1937, there were 284 cases with 5 deaths, but since then scarlet fever has remained at a rather high endemic level, so that down to the time of writing (apparently the end of 1937) 410 patients had been treated in hospital. The circumstantial evidence that the epidemic was due to the distribution of infected milk from a particular dairy is extremely strong. This establishment did not pasteurize the milk; in the family of one of the distributors was a child suffering from scarlet fever with otorrhœa. A singular coincidence was that in Danish Schleswig-Holstein a precisely similar epidemic occurred almost contemporaneously (again distribution of raw milk and association

with a patient having scarlet fever with otorrhœa) although connexion between the two outbreaks could be wholly excluded. General hospitalization of cases was enforced. The routine practice was to retain a patient four weeks in hospital; the number of return cases was rather large. The author insists on the importance of universal pasteurization, remarking that this measure is extremely unpopular not only among small distributors but among consumers who, in Schleswig-Holstein, seem particularly to dislike the taste of heated milk.

M. GREENWOOD.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

PAUL, H. **Present Practice in Regard to Quarantine and Disinfection.**  
*Pub. Health.* 1938, v. 51, 203-6.

The general procedure in public health practice as regards exclusion of contacts of infectious disease from school is laid down by the memorandum of 1927 of the Board of Education; in the case of terminal disinfection, beyond the methods generally accepted, there are no definite regulations as to the exact procedure. Dr. Paul is a heretic, with the courage of his convictions, in both these matters.

As regards contacts of cases of infectious disease, his thesis is that they should not, for that reason, be automatically excluded from school, with certain exceptions, e.g. in rural areas, institutions, public schools, on grounds of expediency, also all contacts in cases of smallpox.

The basis of Dr. Paul's argument is that these contacts, if excluded and capable of passing on the infectious disease, are more likely to infect younger children, at an age, especially in the case of measles, whooping-cough and diphtheria, when the disease is likely to be more serious. The same contacts, if allowed to attend school, might occasionally cause additional cases of infectious disease among other children at school. On a balance Dr. Paul is convinced that there is no increase in the total amount of cases of infectious disease by allowing the contacts to attend school, and less danger of severe or fatal cases among the cases infected at school. Dr. Paul has, with the good will of the medical profession, had the system in being in Smethwick for eleven months. During the period there has been a substantial reduction in the incidence of scarlet fever and diphtheria. The pre-school incidence has been, in the case of diphtheria, reduced by 19 per cent, and the school incidence increased by 18 per cent, as was to be expected.

Terminal disinfection and disinfection of books, as they give a false sense of security, should be replaced by a thorough airing and cleansing of the room, the bed and bedding, with soap and water, etc., under supervision of the Sanitary Inspector. This applies to diseases with organisms easily destroyed, e.g. whooping-cough, measles, scarlet fever, diphtheria. Dr. Paul excludes tuberculosis, enteric fever and scarlet fever.

As regards disinfection of library books, this is compulsory under the Public Health Act, 1936, Section 155. Dr. Paul does not consider the

danger of infection from library books a serious matter, at any rate as compared with the infective spray from the throat and nose of an actual case.

As a result of discussion the following resolution was carried:—

“That the Council of the Society of Medical Officers of Health represent to the Board of Education and the Ministry of Health that the recommendations contained in their Memorandum of 1927 on ‘Closure of and Exclusion from School’ are no longer in accordance with recent advances in epidemiological knowledge and that the Memorandum be redrafted and revised accordingly.”

G. R. BRUCE.

*Reprinted from “Bulletin of Hygiene,” Vol. 13, No. 7.*

HONE, F. S. **Marriage and Tuberculosis: the Public Health Aspect.**  
*M. J. Australia.* 1937, v. 2, 866—70.

This paper considers the subject primarily from the point of view of the public health administrator. Some form of clinic or dispensary is considered to be the central point of any national campaign for the prevention of tuberculosis and it is here that advice must be given on the question of marriage and tuberculosis. The problem in regard to young adults seeking advice is generally reduced to two questions: (1) The probable effect of marriage when one or both of the contracting parties have shown clinical evidence of pulmonary tuberculosis without having had tubercle bacilli in their sputum, and (2) the effect where one or both of the contracting parties are in the open stage and therefore infective. The first group is regarded as mainly an economic problem centring round questions of employment, home comforts, etc. The second question is answered by citation of figures as to marital tuberculosis. The first figures quoted are those of: (1) Verco (500 cases of married men and women who had died of pulmonary tuberculosis), who shows that in nearly half the cases the wife had fallen a prey to her husband's complaint, whereas only one man in eight had contracted the disease from his wife. (2) Scott Pinchin, who cites 166 histories of married couples, in 38½ per cent of these unions infection having passed from one partner to another. (3) Opie and McPhedan who reported results on 553 married couples showing that husbands and wives in marital contact with tuberculosis are infected from five to nine times as often as persons with no such contact. The author concludes, therefore, that medical men should be unanimous in counselling abstinence from marriage in open cases, the only exception being very special cases in which marriage is entered into with the eyes open with the object of securing better attention or treatment for the patient. With regard to interruption of pregnancy the author finds it difficult to be dogmatic, but he is quite dogmatic on the question that there should be no exception to the rule that no mother with active tuberculosis should be allowed to nurse her infant, and he would not hesitate to use legal powers, if available, to

enforce this. He also thinks that legal powers for the segregation of cases should be given to public authorities.

[This subject of tuberculosis and pregnancy has become a common one for discussion at medical conferences. The combined sections of obstetrics and tuberculosis discussed it at the British Medical Association meetings held in Oxford in 1936. A short report will be found in the *British Medical Journal*, 1936, ii, 295. Four main conclusions appear to the reviewer to stand out in these discussions: (1) There are almost as many exceptions as rules. Obviously each case must be dealt with strictly on its merits. (2) Psychological aspects of the problem have been very much overlooked. (3) Interruption of the pregnancy is associated with considerable risks. (4) A continuous sanatorium régime during the months of pregnancy and for some time afterwards has not been tried out as fully as it might be, presumably because of the economic difficulties.]

S. ROODHOUSE GLOYNE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

BUTLER, G. G. **The Keeping Qualities of Vaccine Lymph.** *J. Hygiene*. 1938, v. 38, 120—28, 4 charts.

The tests described were carried out to investigate the retention of potency by vaccine lymph at the temperatures likely to be encountered after the lymph leaves the laboratory and before it is used by the public vaccinators. Three samples of each of three lymphs were stored at  $-10^{\circ}$ ,  $+5^{\circ}$  (ice box) and  $+15^{\circ}$  C. At intervals tests were made of their potency by a method complying with the requirements of the British Therapeutic Substances Regulations, 1931. Tests of the three samples stored at  $-10^{\circ}$  C. for 125 days showed no apparent deterioration in any of the three, but tests of the samples stored at  $+5^{\circ}$  and  $+15^{\circ}$  C. showed that one of the lymphs lost its potency much more rapidly than the other two. That is to say this lymph, although it was able to pass the test ordinarily used before a lymph is issued, was lacking in the reserve potency necessary to enable it to remain potent at higher temperatures. When this lymph was subsequently examined with a view to being issued for use after twenty-seven months' storage it was found to be of insufficient potency. Thus examination of lymph samples stored at  $+5^{\circ}$  and  $+15^{\circ}$  C. will reveal weak potency earlier than the routine examination before issue of lymph stored at  $-10^{\circ}$  C. It is suggested that a suitable guide to the issue of lymph of satisfactory potency would be the examination of a sample which had been stored for the period of guarantee at a temperature to which it was likely to be subjected.

It was found that a lymph made up in 50 per cent glycerol with  $\frac{1}{2}$  per cent phenol when exposed to temperatures of  $-10^{\circ}$ ,  $+5^{\circ}$  and  $+15^{\circ}$  C. retained its potency rather better than lymph made up in the normal manner in 50 per cent glycerol with 0.1 per cent clove oil.

O. K. WRIGHT.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

## Reviews.

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RESEARCHES PUBLISHED FROM THE LABORATORIES OF THE LONDON HOSPITAL, 1937. London : H. K. Lewis and Co., Ltd. Price 7s. 6d. net.

The researches published from the wards and laboratories of the London Hospital during 1937 contain a wealth of material covering a very wide field. Professor S. P. Bedson, under the title "Some Reflections on Virus Immunity," discusses many aspects of this interesting problem and shows that despite similarity which is to be found in the mechanism of immunity to virus, differences exist which, though superficial, are often so great as to make it illusory to talk of virus immunity as though it all conforms to a common pattern : each has its special feature and peculiarity. Another paper by the same author on "Observations on the Complement Fixation Test in Psittacosis," shows that the use of a heated antigen is superior to crude virus suspension for carrying out this test. This antigen is less dangerous to handle and makes the test more delicate, besides keeping better.

Dr. Russell Brain discusses the neurological sequelæ of spinal anæsthesia and describes the post-mortem neurological findings. Dr. J. F. Flemming Brock and Dr. Donald Hunter write on the fate of large doses of iron administered by the mouth. They find that the retention of iron is much greater than has been inferred from the rate of hæmoglobin response. Dr. J. B. Byrom describes the morbid effects of vasopressin on the organs and vessels of rats and shows how gross lesions in the kidneys, liver and arteries may result. He contrasts these changes with those observed in eclamptic toxæmia. Mr. Hugh Cairns' paper dealing with investigations on injuries of the frontal and ethmoidal sinuses with special reference to cerebrospinal rhinorrhœa and aéroceles is included. There is a paper on "The Prognosis following Recovery from Coronary Thrombosis with Special Reference to the Influence of Hypertension and Cardiac Enlargement," by Dr. S. H. Palmer. Dr. John Parkinson and Dr. Clifford Hoyle's investigations on "The Heart in Emphysema" are also included. This publication contains many other papers of great interest. A. G. B.

CLIMATE AND ACCLIMATIZATION. Some Notes and Observations. By Sir Aldo Castellani, K.C.M.G., D.Sc., M.D., F.R.C.P., Count of Kisymao. Pp. x + 198. London : John Bale, Sons and Curnow, Ltd. Price 10s.

The author emphasizes the point that this book does not aim at being an exhaustive work but is merely a collection of notes based chiefly on personal experience gathered in long sojourns in many tropical countries.

In actual fact the book of which this is the second edition is very much more than this and in a comparatively small compass gives much information in regard to the subject with which it deals.

In the first chapter climatology in general is discussed and a very clear picture of the important factors in the situation are put concisely before the reader with special reference to the tropics and subtropics, and to temperature and humidity.

In logical sequence the author then proceeds to deal with the effects of temperature and humidity on the various parts and systems of the body and gives a most valuable résumé, from the point of view of the Army medical officer, or indeed of any medical man practising in the tropics, of the ætiology, distribution, predisposing causes, morbid anatomy, symptomatology, treatment, etc., of the various manifestations of the effects of heat on the human being.

The writer then discusses pressure, winds, electrical conditions and the sun's rays and the influence they severally exert on the health of man, and completes the book with a useful chapter in which acclimatization and the adaptation of European women and children to tropical climates are gone into in detail. In addition the question of white troops in the tropics receives detailed attention, and the guiding principles to be followed if the effects of tropical and subtropical climates are to be mitigated as far as possible, are laid down.

The book is a valuable one to the medical officer proceeding to or practising in hot climates and should undoubtedly form part of his armamentarium.

A. E. R.

CHRONIC RHEUMATIC DISEASES. (Being the Fourth Annual Report of the British Committee on Chronic Rheumatic Diseases appointed by the Royal College of Physicians.) Edited by C. W. Buckley, M.D., F.R.C.P. 1938. Pp. xii + 160; 5 plates. Royal 8vo. London: H. K. Lewis and Co., Ltd. Price 10s. 6d. net.

From the preface we learn that with the publication of the fourth volume, this series of Reports on Chronic Rheumatic Diseases comes to an end. As, however, an enormous amount of research is being done in connection with the various aspects of the subject, we are glad to learn that this series will be replaced by one which will appear at more frequent intervals.

After a short foreword by Lord Horder, the book opens with a chapter to show that the voluntary hospitals and the British Spas cannot solve the problem of rheumatic diseases because of the lack of bed accommodation, special materials, the hitherto luke-warm attitude of the medical profession towards the problem, and also because there is an insufficient supply of graduates suitably trained for the treatment of chronic rheumatic diseases.

In the opinion of the writers, Davidson and Duthie, the most urgent problem in connexion with these diseases lies in the field of politics, viz. the education of the people regarding the gravity of the scourge and the bringing of pressure to bear to provide the necessary facilities for treatment.

The subject of arthritis and rheumatism in the United States, including notes on current researches and opinions on various forms of treatment, is well set forth by P. S. Hench. The succeeding chapters upon the Neurological and the Orthopædic Aspects of Sciatica and the Cause of Sciatic Pain, by Denis Brinton, Arthur Wesson and G. D. Kersley respectively, are excellent in every way.

Schlesinger and Signy provide an informative article on virus as a cause of acute rheumatism, but state that although "elementary bodies" have been isolated from acute rheumatic sources, these bodies have failed to reproduce the disease and the writers are forced to the conclusion that at present the problem must remain unsolved.

The value of vaccines in the treatment of acute rheumatic states is discussed by E. C. Warner, from which it is learnt that vaccines prepared from hæmolytic streptococci and most other organisms have proved of little value and, further, that there is no evidence that the intravenous administration of such vaccines would produce any better results. It remains an open question whether vaccine therapy has any beneficial effects on rheumatoid arthritis and at best this form of therapy can only be considered as one line of attack. Osteo-arthritis, being a degenerative arthritis, is not directly influenced by vaccine treatment.

In the next chapter, C. Trist Gasking discusses the influence of gold salt—Solganal B. oleosum—upon the blood-platelets. The injections of the gold salt depresses the platelet count and the author advises frequent platelet estimations during treatment by gold in order to guard against so great a reduction in platelets as to lead to hæmorrhagic complications. The higher the initial platelet count the greater tolerance to gold. Evidence is produced to show that gold does not permanently damage the platelet-forming tissues.

Phillip Ellman and John S. Laurence describe their methods and the results of the treatment of selected typical cases of rheumatoid arthritis by Solganal B. oleosum intramuscularly compared with selected controls receiving intramuscular injections of almond oil. The mode of action of gold is discussed and the toxic effects upon the various bodily systems are briefly detailed. This chapter is full of useful information.

The concluding chapter by Leonard Hill and H. J. Taylor gives a very good account of the action and effects of treatment by the various forms of heat, by rays, by high frequency and radium.

The authors of this volume and its predecessors have performed their task well and with great ability.

R. P.



## Correspondence.

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### MECHANIZATION AS IT AFFECTS THE MEDICAL SERVICES.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

SIR,—With reference to the reply to my article by Major F. W. Richardson, in the July number of the Journal.

Major Richardson states: "The disappearance of the horsed ambulance wagon abolishes the need for a stage at which wounded are transhipped from horse-drawn to mechanical vehicles." The context leads one to the idea that this stage is the A.D.S. I consider this idea to be wrong.

The organization for the evacuation and treatment of wounded is based on an "object," viz., to give the wounded the most efficient treatment possible. The two-dressing station organization was imposed on us by slow-moving transport, so slow that it was essential, in order to attain the "object," to have a place at which splints and dressings could be adjusted, where it could be assured that reactionary hæmorrhage had not started, and restoratives could be given, etc.

As slow-moving transport has given way to fast-moving transport, surely the necessity which determined the two-dressing station organization has ceased to exist.

Further, keeping the "object" in view, it does not follow that the A.D.S. would be done away with. The one dressing station, according to the situation, would be sited to best advantage, sometimes further up, sometimes further back.

The prefix "Adv." or "Main" should be done away with.

As regards gas cases, we only decontaminate wounded. The effect of mustard gas will be seen more in back areas (near the dressing station), than amongst front line troops. It is highly probable that they will only be affected when the enemy are retreating, in which case the dressing station would be as far up as possible.

It is quite possible that owing to a Division now being so spread out, the Divisional Field Ambulances will not be able cope with casualties far back, say amongst the Supply Column, etc., and it may almost be expected that the effect of mustard gas will be concentrated along routes and halting places behind the fighting troops. In this case an organization providing an A.D.S. for a forward area, solely on account of mustard gas, would be out of place.

It is obvious that a complete solution to the problem of mechanization and its effects on our Corps present many difficulties.

As regards the one dressing station being unorthodox. The answer is partially given by the reference to the 1st and 5th Armies; also, if nothing new was ever attempted, there would have been, for instance, no re-organization or mechanization of our Army.

*Tanglin,*  
*Singapore,*  
*August 28, 1938.*

I am, etc.,  
R. G. ATKINS,  
*Lieut.-Colonel, R.A.M.C.*

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## THE MEDICAL SERVICES DURING THE SEVEN YEARS WAR.

TO THE EDITOR OF THE "JOURNAL OF THE ROYAL ARMY MEDICAL CORPS."

DEAR SIR,—In reading an interesting article by Lieutenant-Colonel Kempthorne on the medical services during the Seven Years War, I have come across a somewhat inaccurate statement about Dr. Donald Monro. In speaking of Donald Monro's "observations on the means of preserving the health of soldiers" Colonel Kempthorne says:—

"The author was the son of John Monro who had served as a surgeon in the Army of William III, and later, when Professor of Anatomy at Edinburgh, lent his help to the wounded after the battle of Preston Pans. His grandfather, Sir Alexander Monro, fought on the King's side at the battle of Worcester."

John Monro was not the father of Donald but the grandfather. John Monro's only son, Alexander Monro *primus* was the person who became the first Professor of Anatomy in Edinburgh, and, as Colonel Kempthorne says, lent his help to the wounded after the battle of Preston Pans, and Donald Monro was his second son. Sir Alexander Monro, who fought at the battle of Worcester, was not Donald's grandfather, but his great grandfather.

*University of Otago,*  
*Dunedin, N.Z.*  
*September 27, 1938.*

I am, etc.,  
W. J. MULLIN,  
*Librarian, Otago Medical School.*



## Notices.

### CHADWICK PUBLIC LECTURES, 1938.

Date and Time	Place	Lecturer	Subject	Chairman
1938. November. Tuesday, 8th, 5.30 p.m.	LONDON. The Royal Society of Tropical Medicine and Hygiene, 26, Portland Place, W.1 (Manson House)	Sir Stanley Woodward, C.M.G., C.B.E., M.D., B.Sc., F.R.C.P., M.R.C.S.	The Rise and Fall of Certain Diseases Con- current with the Progress of Sanitation and Hygiene	Miss Zoë Puxley, O.B.E. Chadwick Trustee
Thursday, 24th, 5.30 p.m.	MALCOLM The Royal Institute of British Architects, 66, Portland Place, W.1	MORRIS MEMORIAL W. W. Wakefield, Esq., M.A., M.P.	LECTURE : Playing Fields and the National Fitness Movement	Sir Lawrence Chubb
December. Tuesday. 13th, 5.30 p.m.	The London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1	Leonard Colebrooke, Esq., M.B., B.S.	The Control of Puerperal Fever	Dame Louise Mellor, D.B.E., LL.D., M.D., D.Sc., F.R.C.P.

Admission Free.

### COMMANDANT, OFFICERS' CONVALESCENT HOME, OOTACAMUND.

APPLICATIONS are invited for the post of Commandant of the Officers' Convalescent Home at Ootacamund from retired European officers of the Royal Army Medical Corps, late Royal Army Medical Corps, or Indian Medical Service.

The terms of the appointment are :—

- (i) Salary of Rupees 300 per mensem in addition to retired pay plus free quarters, lighting, fuel and board, for himself and his wife, who will assist him.
- (ii) The tenure will be for so long as the officer's services are required and will be subject to three months' notice on either side.
- (iii) The officer will normally be required to vacate the appointment on attaining the age of 60. An extension for a specified period may, however, be granted.

(iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorized representative shall be the sole judge.

(2) Applications should be addressed to the General Officer Commanding-in-Chief, Southern Command, Poona, India, and should reach him by January 1, 1939, at the latest. The selected officer will be required to join the appointment about March, 1939.

(3) This supersedes the "Notice" published in the June and July issues of the Journal.

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#### SIBLIN.

WE are informed by Parke, Davis and Company that they have prepared Siblin for the systematic treatment of constipation, either acute or chronic. It is largely made up of highly water-absorbent fibre derived from certain species of plantago. Siblin is stated to contain in each heaped teaspoonful, 50 International units of crystalline vitamin B<sub>1</sub> (Crysto-Vibex) which facilitates improvement in muscular tone and peristaltic function.

Siblin is a granular substance with a pleasant, slightly sweet, salty taste. It may be taken dry and chewed as breakfast cereal often is, or stirred in water or other liquid. Being highly water-absorbent, the granules when saturated, swell greatly, forming a soft gelatinous mass.

The fibre contained in Siblin is stated not to be perceptibly affected by digestive ferments, passing through the stomach and bowels unchanged. It is non-irritating and provides salutary bulk, which facilitates movement through the sigmoid colon and rectum.

The dose of Siblin is one or two teaspoonfuls morning and night and it is issued in lever-lid tins of approximately 4 ounces.

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#### M. AND B. 693 IN PNEUMOCOCCAL INFECTIONS.

WE have received from Pharmaceutical Specialties, of May and Baker Limited, a copy of a booklet entitled "M. and B. 693 in the Treatment of Pneumococcal Infections." This publication deals with the method of administration of M. and B. 693, the dosage scheme to be adopted in cases of lobar pneumonia in children and adults, and broncho-pneumonia in children. A further section gives general notes on the treatment of other forms of pneumococcal infections.

We are advised that copies of this booklet are available to members of the medical profession on request.

### EDITORIAL NOTICES.

The Editor will be glad to receive original communications upon professional subjects, travel, and personal experiences, etc.

Correspondence on matters of interest to the Corps, and articles of a non-scientific character, may be accepted for publication under a nom-de-plume.

**All Communications or Articles accepted and published in the "Journal of the Royal Army Medical Corps" will (unless the Author notifies at the time of submission that he reserves the copyright of the Article to himself) become the property of the Library and Journal Committee, who will exercise full copyright powers concerning such Articles.**

A free issue of twenty-five reprints will be made to contributors of Original Communications and of twenty-five excerpts in the case of Lectures, Travels, Clinical and other Notes, and Echoes of the Past.

Reprints or excerpts, additional to the above, can be furnished on payment if specially ordered at the time of submission of the article for publication.

Communications in regard to editorial business should be addressed—**"The Editor, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, War Office, Whitehall, London, S.W. 1."**

### MANAGER'S NOTICES.

The Annual Subscription for the JOURNAL OF THE ROYAL ARMY MEDICAL CORPS is £1 payable in advance. Single copies, 2s. 6d. per copy.

**Cheques, etc., should be made payable to the "Journal R.A.M.C.," and crossed "Holt & Co."**

Each subscriber who pays his subscription direct to the Manager will also receive monthly a copy of "The R.A.M.C., The A.D. Corps, and Q.A.I.M.N.S. *News and Gazette*."

Communications in regard to subscriptions, change of address, etc., should be addressed **"THE MANAGER, JOURNAL OF THE ROYAL ARMY MEDICAL CORPS, A.M.D.2, WAR OFFICE, WHITEHALL, LONDON, S.W. 1."**

### ADVERTISEMENTS.

*Communications regarding Advertisements should be addressed—*  
**G. STREET & CO., LTD., 8, SERLE STREET, LONDON, W.C. 2.**

# Safe Intravenous Anæsthesia with

# 'EVIPAN' SODIUM

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**STERILIZATION OF GLASSES, CROCKERY AND CUTLERY.**

BY COLONEL A. C. HAMMOND SEARLE, M.C.

WITH the introduction into barracks of modern dining hall blocks, complete with well designed ancillaries for food preparation and washing-up and a constant supply of steam, the potentially adverse influence of former individual and faulty methods of washing messing utensils may be presumed to have been lessened or eliminated.

In the absence of the above improvements, and especially of a constant steam supply, the problem remains largely as heretofore, and from time to time apparatus, chiefly of an improvised type, which aimed at improvement over the usual individual methods of washing-up so obviously open to criticism, have been designed by medical officers specially interested in the subject and published in the Journal.

Though divergence of opinion exists as to the part played by faulty washing-up methods in the spread of saliva-borne diseases, it will be conceded as desirable that such possible influence should be minimized by the general employment in the Army of hygienic methods aiming at sterilization or next door to it.

It is improbable that actual sterilization is commonly achieved in private residences, even though washing up may be hygienically carried out with the use of plenty of really hot water.

Most of us would probably prefer to think that actual sterilization is

carried out in such public restaurants, etc., as we may happen to frequent, though it may be doubted whether this is in fact the case.

Bearing in mind therefore the communal character of the soldier's life it would seem desirable that one should aim at the highest possible standard which is practicable, achieving either actual sterility of messing utensils or at least approximating to it.

The present investigation has accordingly been undertaken as the result of a specific request for an apparatus which would sterilize crockery, etc., efficiently and independently of a constant steam supply.

With this object in view an apparatus was accordingly designed.

#### DESCRIPTION OF APPARATUS.

The Sterilizer consists of (1) Galvanized steel tank (20 S.W.G.) of the following internal dimensions: Length 22 inches, width 13 inches, depth  $14\frac{3}{8}$  inches. It is fitted at the top with a  $1\frac{1}{2}$  inch flange (with lifting handles attached) by means of which the tank is suspended on the upper edges of the walls of an outer jacket (2).

(2) A heat-retaining outer jacket and fire-box combined, lagged internally with  $\frac{1}{4}$  inch asbestos sheeting, except where these are perforated by air holes (1 inch diameter) and a port ( $9\frac{1}{2}$  inches high by 10 inches) for admission of the burner. On the side opposite to that on which the burner is inserted the wall carries a recess (outwards, 9 inches high by  $6\frac{1}{2}$  inches by 2 inches deep) to admit of the burner being centrally placed. The top and bottom are strengthened by the inclusion of a  $\frac{1}{4}$  inch steel rod. There are two drop handles for lifting purposes (figs. 1-3).

(3) A Turley and Williams (No. 12) petrol burner with (1 gallon) galvanized iron petrol tank, fixed on a stand as a single unit (figs. 1 and 3).

(4) Racks (3-tiered) to hold (a) 30 cups and (b) 30 tumblers (figs. 4, 5 and 6).

(5) Plate rack to hold 11 plates (fig. 7).

(6) Handles for convenience in lifting the plate racks out of boiling water (fig. 8).

(7) Wire basket—for sterilization of knives, forks and spoons (fig. 9).

#### CAPACITY OF THE TANK.

The amounts of water required to cover the various racks and their contents are as follows: (1) Rack containing 11 plates—10 gallons. (2) Rack containing 30 cups— $10\frac{1}{2}$  gallons. (3) Rack containing 30 tumblers—9 gallons.

The water level should be such that with the contents completely immersed there is sufficient depth to prevent loss of water by boiling over.



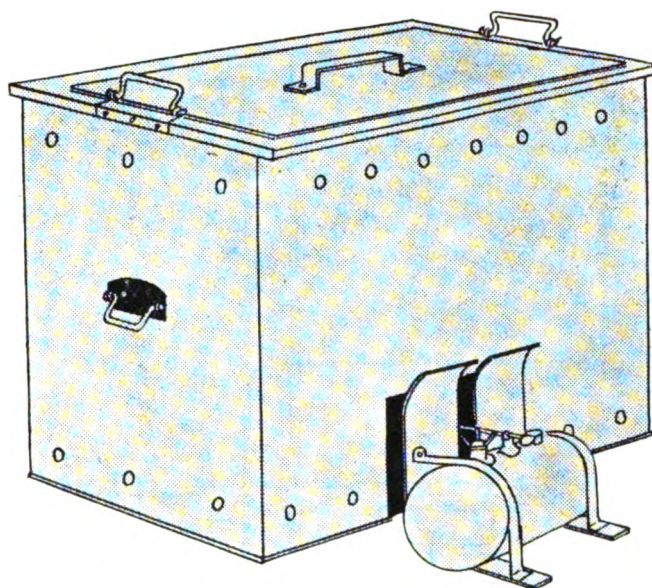


FIG. 1.—Sterilizer box with burner in position.

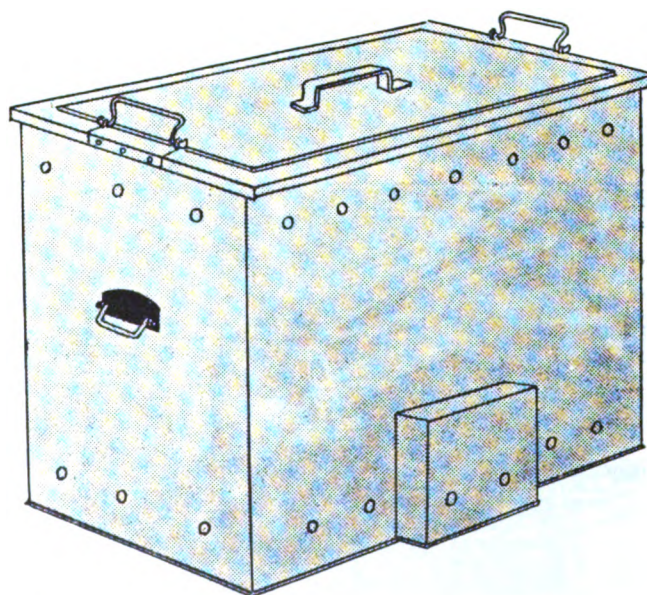


FIG. 2.—Sterilizer box showing rear extension for burner.

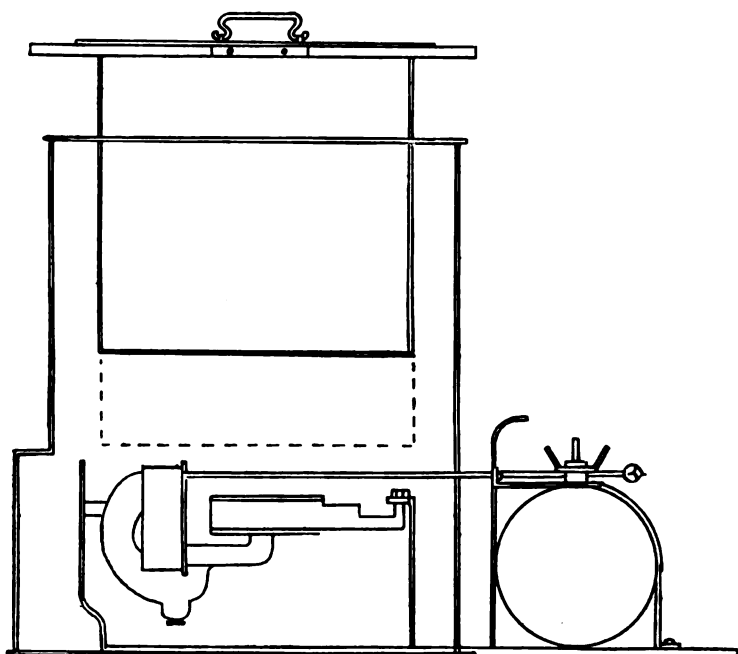


FIG. 3.—Cross-section of side view.

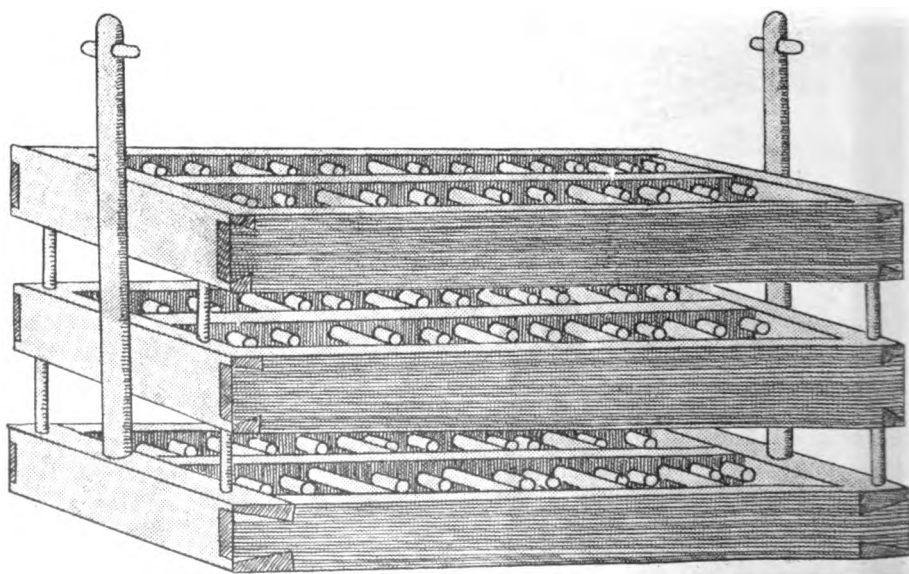


FIG. 4.—Cup rack (triple).

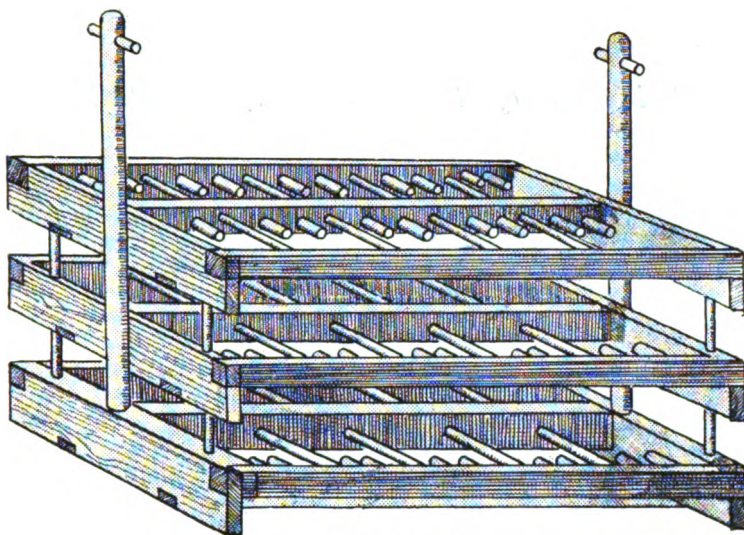


FIG. 5.—Glass rack.

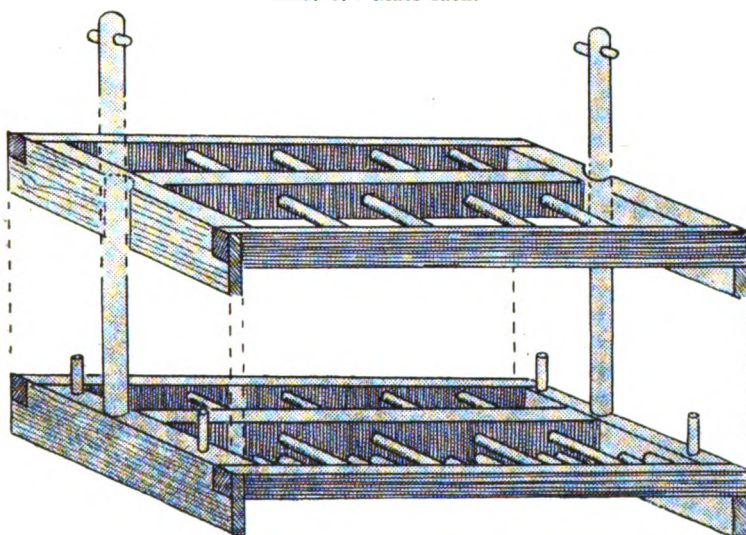


FIG. 6.—Glass rack.

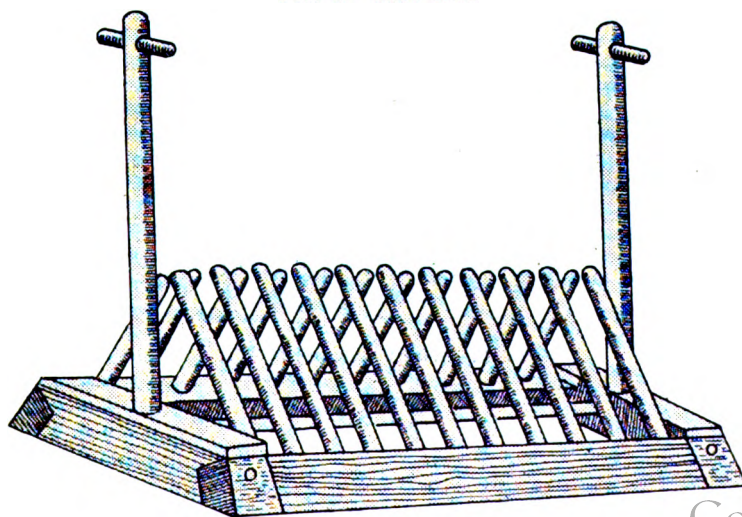


FIG. 7.—Plate rack.

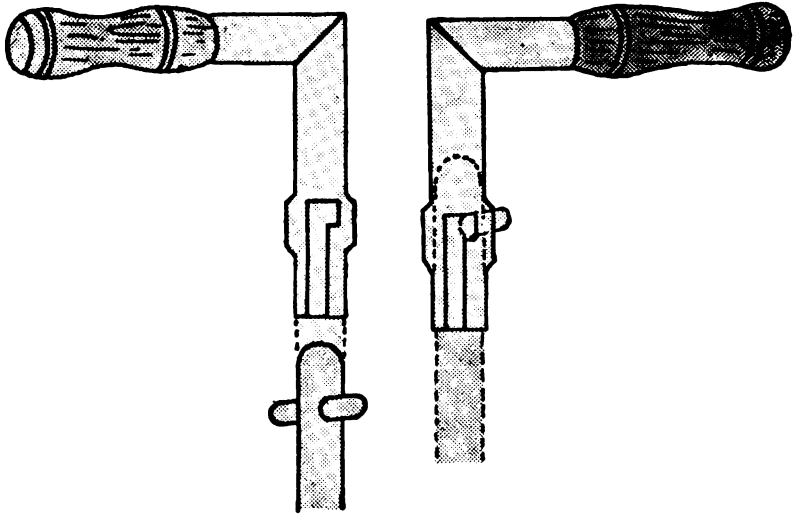


FIG. 8.—Handles fitted with bayonet catch to fit over the permanent handles of glass rack or cup rack when in use. Also over handles of plate rack.

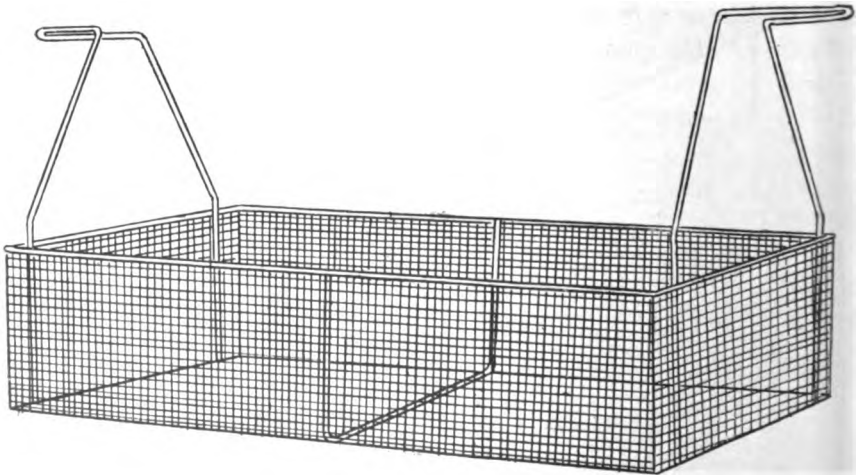


FIG. 9.—Wire sterilizing basket.



With the present size of tank it has been found that with the cup rack (which has the greatest vertical depth of the three) full and completely immersed the water level is some three inches below the top of the tank, which is sufficient for the purpose.

#### TURLEY, WILLIAMS (PETROL) BURNER.

##### *Details of Management.*

By means of a foot pump the air pressure in the petrol tank is raised to 25 pounds.

The burner is lighted by turning on the tap completely at first and is then adjusted as required.

The air pressure drops to about 15 pounds as the result of this procedure and must be restored to and kept at approximately 25 pounds per square inch if the maximum efficiency of the burner is to be maintained.

The loss of pressure during working is some 3 pounds per ten minutes, and must be restored accordingly from time to time.

##### *Time of Boiling.*

With an initial temperature of 12° C., 10 gallons of water boiled in twenty-nine minutes.

#### RÉSUMÉ OF EXPERIMENTAL WORK.

The apparatus having been proved capable of boiling the contained water in a reasonable time, the problem of its practical efficiency as a sterilizer resolved itself into an investigation of the minimum time and minimum temperature at which the organisms likely to be most commonly met with will be destroyed.

The available data on this subject were found to be very meagre, and the only observation of practical use was that momentary immersion at 180° F. is sufficient to kill pathogenic bacteria commonly conveyed by water.

Earlier experiments made with organisms put up in thin-walled capillary tubes were found to give inconsistent results, so that the method was abandoned. Thereafter sectors of plates were contaminated direct, immersed for varying times at varying temperatures and tested for sterility. It was proved that sterility, if obtained, is not due to washing off of the organisms, since abundant growth was obtained after immersion of contaminated plates in cold water.

##### *Organisms Used.*

Preliminary experiments were carried out with a stock culture of *Bact. coli*. Later, cultures of the following throat organisms were obtained: *Staphylococcus aureus*, *Staph. albus*, *M. catarrhalis*, *M. pharyngis siccus*, *C. xerosis*.



The majority of the experiments were carried out with *Staph. aureus*, and it was then proved that none of the other organisms outlived it under similar conditions.

The most likely thing to happen in practice is that immersion is carried out for a shorter time than may be required and in water that is not hot enough to sterilize the articles.

#### *Time of Immersion.*

The shortest time is, of course, "momentary" immersion. With small objects, such as capillary tubes, this time was found by means of a stop-watch to be about four-fifths of a second, but with a larger and heavier object, such as a rack full of plates, immersed in a tank which on account of its somewhat restricted shape required relatively careful insertion of the rack, the time of a momentary dip was found to be about two and a half to three seconds. In practice, therefore, it is unlikely that a rack full of crockery will be subjected to a period of immersion much less than four-fifths of a second.

#### *Temperature.*

As the result of several experiments it was found that the critical temperature for a momentary dip was 80° C. At this temperature, even with a momentary dip, sterilization can be confidently assumed to have occurred; at 75° C. this is not the case. In the circumstances no further interest attaches to certain early experiments by which it was shewn that immersion of a rack full of cold plates—in winter—reduced the temperature of the water by some 3° C. It is, however, of academic interest to note that when the period of immersion was thirty seconds or over the initial loss of temperature was counterbalanced by the rate of heating. The temperature began to rise, the water was simmering before the period of immersion was completed, and was boiling furiously again one minute afterwards, even with the lid off. It must be assumed that when the apparatus is in use for actual sterilization the lid will in practice be off; it would be replaced only when loss of water necessitated reheating.

Since the heat of the water is the only sterilizing agent employed, the paramount importance of employing water at the necessary lethal temperature will be obvious. It was, therefore, decided to visit the Institute of a unit whilst washing up was actually in progress and carry out the necessary investigations.

It was found that the "sterilizing" water which was being reheated "as required" by means of a steam jet in the sink to what was presumed to be boiling point or near it, had in fact only a temperature of 67·5° C.

As has been shown above, with a "momentary dip" this is not sufficient to cause sterilization, and the process may therefore have been ineffective in this case.

It was, however, found, somewhat against expectations, that this water (at  $67.5^{\circ}\text{C}.$ ) in which the washed plates were being dipped, was sterile. No doubt this was due to the fact that (a) live steam had been passed into it a number of times and (b) that the water as a whole had been subjected for a relatively long period of time to a temperature as high as or higher than  $67^{\circ}\text{C}.$  In addition it was noted that each rack was being dipped twice, so that the total period of immersion must have been four to five seconds.

At a second visit to the same unit further information was obtained. It was found that crockery, etc., was habitually washed up in three phases. It was at first soaked in hot water for a period of some fifteen minutes to prevent drying and hardening of the food debris remaining on the plates. It was next washed in the mechanical washer at a temperature of  $75^{\circ}$  to  $70^{\circ}\text{C}.$ , and finally "sterilized" by immersion in the racks in the water (steam heated) in the sterilizing tank. It was found that immersion was NOT being done twice as on the occasion of the first visit and that the time of immersion varied between three and six seconds; the temperature of the water, which was  $93^{\circ}\text{C}.$  at the commencement of the operation, fell to  $75^{\circ}\text{C}.$  before completion. It is thus doubtful whether sterility could have been obtained in all cases.

To issue instructions for immersion to be carried out for a definite number of seconds is almost certain to result in failure, but if the orders are to the effect that a rack of plates, etc., should always be immersed twice, it is likely that the average time of exposure would be about five seconds.

In such circumstances, however, it seemed likely that sterilization would be effected at a lower temperature than  $80^{\circ}\text{C}.$ , and an experiment was carried out to ascertain this point.

Using *Staphylococcus aureus* as the test organism it was found that with five seconds immersion sterility was obtained on one occasion at the following temperatures:  $75^{\circ}$ ,  $70^{\circ}$ ,  $65^{\circ}$  and  $60^{\circ}\text{C}.$ , the controls being in all cases positive.

The importance of this result indicated the necessity for repetition of the experiment and on the second occasion, at temperatures of  $60^{\circ}$  and  $65^{\circ}\text{C}.$ , sterility was obtained uniformly only from 5th plate to be cultured onwards in each series, *vide* Series D, Experiment VI (b). The difference in technique between the two experiments was that in the first instance two minutes elapsed before culturing, whereas in the second experiment it was done at once.

It was noted in the second experiment that the growth obtained on the first four plates of each series was extremely sparse. It was all in discrete colonies, and varied from one to seven colonies only.

This result emphasised that the period of sterilization is not measured by the period of immersion only, but, especially in the case of relatively

bulky articles such as dinner plates, continues for some time afterwards owing to the amount of retained heat.

It may also be inferred that a period of immersion of five seconds, plus a certain period of continued exposure to the retained heat of the articles may, even at such low temperatures as 65° or 60° C, cause sterility or very nearly so.

This continuance of sterilizing action is likely to be a usual occurrence in practice, to be more marked in hot weather, and tends to correct errors in technique as regards temperature of sterilizing water and periods of immersion.

In applying the results of the foregoing experiments to the present apparatus it may be assumed the burner will not be extinguished until the washing-up has been completed, and that in consequence the sterilizing water will in practice approach more nearly to boiling point than has hitherto been the case. This will result in an ample margin over the minimum required for sterilization.

If every instruction laid down above is disregarded we still have remaining as a sheet anchor the knowledge that the process is almost certainly being carried out in a sterile water, which at least involves considerable dilution of such organisms as have not previously been washed off or killed.

Dissemination of infection is, of course, not prevented without actual sterilization.

Additional experiments to test: (1) The influence of the addition of soda; (2) the influence of the addition of formol; (3) the sterilizing action of potassium permanganate; are described in the Appendix.

#### APPENDIX

##### Detailed report of Experiments carried out.

##### SERIES A.

I. *Preliminary.* Using the 10 gallon water tank (G.I.) without a lid and a Turley Williams (Experimental) No. 12 burner.

Water, as estimated visually, took fifty minutes to boil, but not furiously. Temperature at the surface was found to be 98·5° C, and at the bottom 99·5° C.

It was noted that the pressure, which had been 40 pounds at the commencement of the experiment, had dropped to 18 pounds. On restoring the pressure the flame was increased to normal and the water at once boiled furiously.

The plate rack containing eleven full size dinner plates was then immersed in the tank and kept in for approximately three seconds. As a result the temperature (at the surface) fell to 97° C and it took some two and a half minutes to reproduce vigorous boiling.

It is interesting to note that anyone seeing the water before the pressure was again raised to normal would have described it as definitely boiling, though not vigorously, and would have thought that this had been the condition for some time. It is therefore to be inferred that no further improvement would have occurred without raising the pressure, and that this is an important detail in management.

It can also be assumed that with a cover and some form of insulating hood the necessary time could be much reduced.

II. *New Apparatus.* Tank and insulating hood, but still using Experimental No. 12 burner. Includes lid and insulating hood around burner and boiler.

*Data.*—(a) Rack full of plates (11) displaces  $1\frac{1}{2}$  gallons. (b) With the plates covered the water level is some 3 inches below the top of the tank, thus allowing sufficient vertical height to prevent boiling over. (c) Rack full of 30 cups displaces nearly 2 gallons; the water level is  $2\frac{1}{4}$  inches below the top of the tank.

Water boiled strongly in forty-five minutes. There was a constant loss of air pressure in the petrol tank, which doubtless accounted for the small amount of improvement.

III. *New Apparatus* (as above) but complete with new burner.

Initial temperature of water  $11.5^{\circ}\text{C}$ , boiled vigorously in thirty-two minutes.

The original normal air pressure for this burner is 25 pounds. On first lighting the burner the pressure falls to 15 pounds, and this must be at once restored to the normal. Thereafter it was observed that the pressure fell about 3 pounds in the course of ten minutes, and must on each occasion be restored to 25 pounds if the optimum result is to be obtained.

IV. The hood was lagged with asbestos. As a result the time of boiling was lowered to twenty-nine or thirty minutes.

V. An experiment conducted to ascertain the rate of heating.

The initial temperature of the water was  $12^{\circ}\text{C}$ . The burner was lighted and inserted at 11.17 a.m.

Results were as follows ;

Hour	Time of heating	Temperature	Gain per 5 mins.
11.22	5 minutes	$31^{\circ}\text{C}$ .	$19^{\circ}\text{C}$ .
11.27	10 "	$40^{\circ}\text{C}$ .	$9^{\circ}\text{C}$ .
11.32	15 "	$55^{\circ}\text{C}$ .	$15^{\circ}\text{C}$ .
11.37	20 "	$71^{\circ}\text{C}$ .	$16^{\circ}\text{C}$ .
11.42	25 "	$88^{\circ}\text{C}$ .	$17^{\circ}\text{C}$ .
11.46	29 "	$100^{\circ}\text{C}$ .	$12^{\circ}\text{C}$ .

No explanation is forthcoming for the slow rate of heating in the second period of five minutes, which follows the greatest increase of temperature achieved (in the first five minutes).

The point of practical importance that emerged is that for over ten minutes the water is at a temperature which will kill non-sporing organisms very quickly or instantaneously.

VI. Experiment to ascertain the fall of temperature from  $100^{\circ}\text{C}$ . due to immersion of a rack of cold crockery. Two racks were used each containing eleven dinner plates—full size.

After immersion each rack was cooled in turn by immersion in cold water, so that they were at least as cold—if not colder—than when immersed for the first time.

Results—			Fall of temperature
(a) Momentary Dip—to	..	..	$98^{\circ}\text{C}$ .
Water boiled again in 1 minute.			
(b) 15 Seconds Dip—to	..	..	$97^{\circ}\text{C}$ .
(c) 30 Seconds Dip—to	..	..	$96.5^{\circ}\text{C}$ .
It was noted that during the dip the water continued to simmer—without the cover. On replacing the cover water boiled energetically again in 1 minute.			
(d) 45 Seconds Dip—to	..	..	$97^{\circ}\text{C}$ .
With the cover remaining off during the period of immersion the temperature began to rise. After withdrawal of the plates boiling point was reached in $2\frac{1}{2}$ minutes—without replacing the cover. This was done as it was conjectured that in practice the cover would not be replaced.			

#### SERIES B.

I. To test the viability of organisms (in sealed capillary tubes) after immersion in boiling water for varying periods of time.

Organism used: *Bact. coli* (Stock culture No. 17, Army School of Hygiene). A number of thin-walled capillary tubes were used for these experiments, each tube containing approximately 0.001 millilitre of a suspension of the organism in sterile saline. Each tube was immersed in boiling water for the required period, placed aseptically in lactose sugar and broken therein.

A control was cultured without dipping.

It was thus proved that *Bact. coli* put up in thin-walled capillary tubes is uniformly killed by momentary immersion in water at  $100^{\circ}\text{C}$ ., and, as is to be expected from that result, also at five, ten, fifteen, thirty and forty-five seconds respectively. (N.B.—A momentary dip was found by the stop-watch to be about four-fifths of a second).

II. To ascertain the viability of *Bact. coli* smeared on to a sector of dinner plates after immersion in boiling water at  $100^{\circ}\text{C}$ .

Six dinner plates (largest size) were smeared with a suspension of *Bact. coli* in sterile saline; the culture was allowed to dry and the following experiments carried out:—

1st plate: This was swabbed and cultured direct on to a MacConkey's plate without being treated in any way (control).

2nd plate: Subjected to momentary immersion in and withdrawal from COLD water and cultured as above.

3rd to 6th plates: Immersed in boiling water for the following times respectively—Momentary (*N.B.*—A momentary dip with a rack full of plates timed by stop-watch was found to be from two and a half to three seconds), five, ten and fifteen seconds.

The technique employed in culturing from dinner plates contaminated with culture of *Bact. coli* was: (a) Small cotton wool swabs were sterilized in a test tube by the autoclave for half an hour. When required each swab was removed from the test tube by sterile forceps, flamed, dipped into boiling water and then cooled in sterile saline. (b) The contaminated dinner plates were swabbed with the sterile swabs and MacConkey's Bile Salt neutral red lactose agar plates were inoculated by smearing with the swabs. No attempt was made to ensure the growth of discrete colonies as only evidence of coliform growth was required.

*Results.*—1st plate (control): Lactose fermenting colonies. 2nd plate (cold water): Lactose fermenting colonies. 3rd to 6th plates: No growth.

By this result it is proved (1) that even "momentary" dipping into boiling water is sufficient to sterilize plates contaminated with *Bact. coli*; (2) that contaminating organisms which have dried on the plates are not removed by mere dipping.

III. To ascertain the viability of *Bact. coli* after immersion for varying periods in water of varying temperatures.

The experiment was conducted under the same conditions as Experiment II, approximately 0.001 millilitre of a suspension of *Bact. coli* in sterile saline being put up in thin-walled capillary tubes.

The results are shown in tabular form below.

	Period of immersion seconds	Temperature ° C.					
		80	85	90	92	94	96
(1)	M	+	—	+	+	—	—
(2)	5	+	+	+	—	—	—
(3)	10	—	—	—	—	—	—
(4)	15	—	+	—	—	—	—
(5)	20	—	—	—	—	—	—
		Control +					

+ Indicates growth of lactose fermenting colonies.

— Indicates no growth.

M Momentary immersion.

These results were not uniform. The nutrient agar plates were in each case subdivided into a number of sectors (5) i.e. organisms submitted

to different periods of immersion at a given temperature were all cultured on different sectors of the same plate. It is therefore possible that the varying results were produced by "splashing."

*Results of Repetition of Nos. (1) and (2).*

(Each experiment on a separate plate.)

Time in seconds	Temperature ° C.						
	80	85	90	92	94	96	98
M	+	+	+	+	—	—	—
5	+	—	—	—	—	—	—

The results are more regular and show that *Bact. coli* is killed by a momentary dip of about one second at a temperature of 94° C. and with a five-second dip at a temperature of 85° C. and higher.

The following organisms obtained from throats had been isolated by this time: (1) *Staph. aureus*; (2) *Staph. albus*; (3) *M. pharyngis siccus*; (4) *M. catarrhalis* and (5) *Corynebacterium xerosis*.

As these and kindred organisms are those which are likely to be met with in actual practice an investigation on lines similar to the above was commenced in order to ascertain their viability at different temperatures and with different times of immersion.

SERIES C.

*Experiment I.*—Organism: *Staph. aureus*.

Medium—nutrient agar.

A suspension containing approximately 0.001 c.c. of the organism was put up in thin-walled capillary tubes—as before.

*Results—*

Time in seconds	Temperature ° C.					
	85	90	92	94	96	98
M	+	—	—	—	—	—
5	—	—	—	—	—	—
10	—	—	—	+	+	—

These results again show inexplicable inconsistencies in that growth was obtained with a ten-second dip at 94° and 96° C. and throws some doubt on the soundness of the practical details of the methods employed.

*Experiment II* was accordingly undertaken to ascertain the reliability of the capillary tube method, in view of the inconsistencies in previous results.

Organism used: *Staph. aureus*.

Medium—nutrient agar. A suspension of the organism was placed in capillary tubes as in earlier experiments.

Ten of these tubes were immersed simultaneously into water at 94° C.

for ten seconds and were then cultured on separate plates of nutrient agar.

The suspension was expelled from the tubes by means of a sterile rubber teat.

A control tube was also cultured.

*Results.*—Control tube—heavy growth.

Of the 10 plates—1 showed considerable growth; 1 showed one colony; 8 showed no growth.

In view of the above results further experimentation with capillary tubes was discontinued, since it was considered that: (a) The test is unduly severe owing to the protection afforded by the walls of the capillary tube; (b) the varying results may be caused by differences in the thickness of the capillary tubes; (c) the conditions do not approximate to those found in actual practice.

Hereafter all experiments were carried out by contamination of dinner plates (N.A.A.F.I. size) with an emulsion of the organism under trial in sterile saline, applied by means of sterile throat swabs.

#### SERIES D.

*Experiment I.*—To test the consistency of results obtained by the above mentioned method.

(a) 10 plates and 1 control contaminated as previously described were subjected to a momentary dip at  $94^{\circ}$  C.

They were cultured after two minutes from the time of withdrawal from the water. The time required for culturing the 10 plates was one minute.

*Result.* All negative. Control +.

(N.B.—The control plate was dipped in the same manner as the remainder in cold, sterile, distilled water.)

*Experiment II.*—Momentary dip at  $80^{\circ}$  C. under conditions identical with (a).

*Result.*—All negative (ten plates). Control +.

The control plate was dipped in the same manner as the others in cold sterile distilled water.

The fact that growth was obtained proves that mere dipping is not sufficient to wash off contaminating organisms—which therefore in actual practice require to be killed by heat.

*Experiment III.*—It was determined at this stage to obtain some idea of the temperatures actually employed in practice and it was accordingly arranged to visit the Army School of Cookery while washing up was being carried out.

(a) The orderly in charge was stopped at the moment when he had re-heated the sterilizing water “as usual” by turning steam into it.

The temperature was found to be  $67.5^{\circ}$  C. only. After a momentary



dip of a plate rack the loss of temperature was  $0.5^{\circ}\text{C}$ . It should be noted, however, that the plates in the rack were still warm from washing; this may be expected to be usually the case, so that the loss of some  $3^{\circ}\text{C}$ . previously found to result from the immersion of a "dead cold" rack of plates is an overstatement compared with what is likely to occur in actual practice.

The momentary dip was done twice in each case and took on the average four seconds.

(b) The washing water containing soda was sampled and the pH found to be 8.2.

(c) The "sterilizing" water was inoculated into the usual quantities of medium as in the bacteriological analysis of water (0.1 to 100 millilitres).

*Result.*—All tubes were negative.

This result was a little surprising, but may be explained by the fact that this water had been at a temperature of  $67^{\circ}\text{C}$ . for a relatively long period, having been reheated by means of live steam to that or some similar temperature as considered necessary.

It will also be noted that organisms on the plates already had been subjected to washing in an alkaline water (soap and soda) pH 8.2 for a certain length of time before they were submitted to the second process of so-called sterilization.

*Experiment IV.*—To ascertain whether *Staph. aureus* on dinner plates is killed by momentary immersion at  $67^{\circ}\text{C}$ . Technique as before.

*Result.*—As expected was 9 tubes + growth; 1 tube —.

*Experiment V.*—To ascertain the minimum temperature at which *Staph. aureus* on dinner plates is killed by momentary immersion.

*Results.*—(a) at  $75^{\circ}\text{C}$ . All plates +. (The last two plates cultured, on which the organisms had been exposed to the heat of the plate for three-and-a-half minutes before culturing, showed very sparse growth.) (b) at  $70^{\circ}\text{C}$ . All plates +. (Heavy growth in all.) (c) Experiment (a) (momentary immersion at  $75^{\circ}\text{C}$ .) was repeated, as the critical temperature was conjectured to be between  $75^{\circ}$  and  $80^{\circ}\text{C}$ .

*Result.*—9 plates +. 1 plate —.

This corroborates the results obtained in Experiment II, Series D, in which it was found that with momentary immersion a temperature of  $80^{\circ}\text{C}$ . is required to kill all the organisms.

*Experiment VI.*—(a) In view of the fact that a momentary dip of a relatively heavy rack full of plates is known to require some two and a half to three seconds, and the fact that this had been observed at the Army School of Cookery to have been done twice in each case, it was decided to ascertain whether a uniformly lethal effect could be obtained at lower temperatures with a five second period of immersion.

Organism used : *Staph. aureus*. Technique as before. Time of

immersion five seconds. Temperature 60°, 65°, 70° and 75° C. Number of plates—5 for each temperature and one control.

*Results.*—After twenty-four hours incubation. Control +. All others —.

In view of the unexpected success of this experiment it was deemed advisable to repeat the experiment.

(b) Repetition of above experiment at 65° and 60° using *Staph. aureus*; *Staph. albus*; *M. pharyngis siccus* and *C. xerosis*.

*Results.*—

	Plates									
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
60° C.	+	+	+	+	—	—	—	—	—	—
65° C.	+	+	+	+	—	—	—	—	—	—
Control	All organisms recovered									

This result does not fully corroborate those obtained in the previous experiment.

It will be observed that a constant dividing line occurs between culture of the 4th and the 5th plates at each temperature.

The explanation may be as follows:—

It will be obvious that plates immersed in water at a given temperature retain a considerable amount of heat on withdrawal from the water and lose it at a rate which is proportionate to the air temperature. In Experiment VI (a) a period of two minutes elapsed before culturing was commenced. During this time the plates and the organisms thereon were cooling—and moreover, somewhat slowly, owing to the recent high temperatures.

It may be said therefore that the organisms were in reality submitted, not only to a five seconds dip at a given temperature, but, on withdrawal from the water, were subjected for at least two minutes to gradually diminishing heat. It is therefore not altogether unexpected, though misleading, to find that sterility was obtained.

In the case of Experiment VI (b) culturing was commenced immediately, so that it may be conjectured that the negative results from the 5th plate onward are due to the fact that the organisms were subjected for a further period of—say five to seven seconds—to the influence of the hot plates.

It is, however, to be noted that growth, where obtained, was extremely sparse. There were only discrete colonies present varying from 1 to 7.

It appears therefore that immersion for a period of five seconds at a temperature as low as 60° C., plus the subsequent continued exposure to a slowly cooling plate, is sufficient to kill off a very high proportion of the organisms present, but may and probably will fall short of a complete lethal action.

On the analogy of the lethal action of chlorine on bacteria in water, it

seems likely that below  $80^{\circ}\text{C}$ . a few organisms are always likely to remain alive.

In practice, however, the exposure of any organisms remaining alive to the continued action of the heat of gradually cooling plates will be the rule, so that even if the temperature of the "sterilizing water" is allowed to fall well below  $80^{\circ}\text{C}$ ., there is the possibility that sterilization may nevertheless result.

*Experiment VII.*—To test the viability of other "throat" organisms similar to *Staph. aureus*, which alone had been tested in most of the previous experiments.

Separate plates were contaminated with (i) *Staph. albus*, (ii) *M. pharyngis siccus*, (iii) *M. catarrhalis*, (iv) *C. xerosis*. Technique as before.

*Results.*—(a) With momentary dip at  $80^{\circ}\text{C}$ .: All tubes — ; control + .

(b) With momentary dip at  $75^{\circ}\text{C}$ .: All tubes + ; control + .

This further corroborates the fact that  $80^{\circ}\text{C}$ . is the critical temperature for a momentary dip, and also that none of the other organisms tested outlived *Staph. aureus* under the same conditions.

*Experiment VIII.*—At the Army School of Cookery.

With reference to Series D, Experiment III, it was decided to pay a further visit to the Army School of Cookery with a view to conducting a more detailed investigation of the methods employed in the normal treatment of "dirty" crockery.

Observations were accordingly made during the "washing-up" after a mid-day meal, the orderly in charge being unaware of the nature and purpose of the observations.

It was found that the washing consists of three distinct phases. The first may be described as "soakage."

As the plates came from the Mess they were placed in a large galvanized iron tank containing hot water. It was explained by the orderly that this was to render his task more simple by preventing drying and hardening of food remaining on the plates. It is impossible to report a definite time for this soaking as this varies with the requirements of the orderly. It was estimated, however, that the minimum time during which any plate was soaking was ten to fifteen minutes, while some were soaking as long as thirty minutes.

The temperature of the water in this tank when the plates were placed in it was  $78^{\circ}\text{C}$ . Hot or cold water respectively was run into this tank while washing-up was proceeding in order to keep the temperature up and yet enable the orderly to remove the plates without scalding his hands, and the final temperature of the water in the tank (when all the plates had been removed) was  $50^{\circ}\text{C}$ .

The second phase is the actual washing of the plates in the mechanical washer. The temperature of the water in the washer while washing was in progress was  $75^{\circ}\text{C}$ ., and at the conclusion  $70^{\circ}\text{C}$ .

The third phase is the process of sterilization in the sterilization tank. As the plates were washed they were placed in a rack and when the rack was filled it was immersed in the sterilizing tank and left there while an empty rack was taken off a shelf above the tank and placed in readiness to receive more washed plates. The full rack was then removed from the sterilizing tank and placed on the shelf. The process was then repeated. The time of each dip was taken with a stop watch. The average time of each dip, ignoring the fourth and eighth dips for the reasons stated below, was four and one-fifth seconds. The full results are tabulated below.

TIME OF DIPPING OF RACKS OF PLATES AT THE ARMY SCHOOL OF COOKERY,  
JUNE 17, 1933.

1st rack ..	..	..	6 seconds
2nd ..	..	..	6 "
3rd ..	..	..	6 "
4th ..	..	..	68½ "
5th ..	..	..	4 "
6th ..	..	..	4 "
7th ..	..	..	3 "
8th ..	..	..	75 "
9th ..	..	..	4 "
10th ..	..	..	3 "
11th ..	..	..	3 "
12th ..	..	..	3 "

Average duration of each dip, neglecting the fourth and eighth dips (see above) is  $4\frac{1}{5}$  seconds.

The times of the fourth and eighth dips, sixty-eight and four-fifths and seventy-five seconds respectively, were due to the fact that the orderly had only four racks and when these were all full he had to empty them of plates before proceeding with the washing. The fourth and eighth racks he left in the tank while he was emptying the preceding three racks. He then removed the fourth and eighth racks from the tank and emptied them before washing any more plates.

The temperature of the water in the sterilizing tank immediately before the immersion of the first rack was  $93^{\circ}\text{C}.$ , during the process (just after the sixth rack had been removed) it was  $85^{\circ}\text{C}.$ , whilst the final temperature, immediately after the steam was cut off, was  $75^{\circ}\text{C}.$

These observations indicate as follows:—(1) The soakage phase may be ignored from the point of view of sterilization as organisms are unduly protected by food debris, etc. (2) The same holds to a lesser degree for the washing of the plates in the mechanical washer. Organisms are, however, exposed for fairly lengthy periods to a temperature which may border on the lethal for the period. (3) The temperature of the water during the third phase was allowed to fall to  $75^{\circ}\text{C}.$  and the shortest periods of immersion were for three seconds only, corresponding roughly to the period found in earlier experiments for a momentary dip of a plate rack. It is also to be noted that on this occasion the racks were not being dipped

twice as had been done at the first visit. In the circumstances it must be conjectured that during the latter portion of the operation sterility was not being achieved.

It is considered to be outside the scope of the present investigation to take up the general question of the efficiency or otherwise of sterilization in Institutes generally.

#### SERIES E.

##### I. Additional experiments :—

Mundel, O. (1937) states as follows: The addition of soda . . . increases the disinfecting power of boiling water. The time of sterilization of a suspension of earth in boiling water was reduced by the addition of soda (to make a 2 per cent solution) from :—

10 hours to	10-30 minutes	at 98° C.
20-40	„	at 95° C.
70-100	„	at 92° C.

It was decided to test this finding by repeating Experiment V, Series D (a momentary dip at 75° C.), in 2 per cent soda solution in the hope that sterilization might result at this temperature in lieu of the previous failures.

Technique as before.

*Result.*—All plates (10) +.

In view of this result the investigation was not continued.

II. Mundel also stated: The addition of 0.25 per cent formol to the 2 per cent soda solution increased its germicidal effect considerably. At 92° C. the sterilization of the earth suspension was complete within fifteen minutes.

Accordingly the necessary amount of formol was added to the 2 per cent soda—and viability tested again with a momentary dip at 75° C.

*Result.*—All 10 plates +.

Although a lethal effect was not obtained as had been hoped, it is worthy of note that after eighteen hours incubation colonies were so sparse as to require careful searching for. After twenty-four hours colonies could be definitely seen; after forty-eight hours colonies were still discrete.

It would thus appear that the addition of formalin had, as is to be expected, resulted in considerable retardation of growth, but NOT, with a momentary dip, in sterility.

It was found, however, that the formalin made the process so irritating that it could not be recommended as a practical routine measure for use in the N.A.A.F.I. Institutes.

III. Griffin (1932) reported the results of steeping the washed utensils used in canteens and cookhouses for five minutes in 1 in 1,000 solution of potassium permanganate, or for two minutes in a slightly stronger solution.

The following experiment was therefore carried out: Organisms used—*Staph. aureus*; *Staph. albus*; *B. xerosis* and *M. pharyngis siccus*.

Saline emulsions of each of the above organisms were swabbed on to two dinner plates. One plate was immersed for five minutes in a 1 : 1,000 solution of potassium permanganate, the other for two minutes in a 1 : 500 solution. Subsequent cultural attempts showed that all the organisms had been killed.

A control plate was inoculated with the four organisms and allowed to dry. This was not dipped into potassium permanganate and all the organisms were successfully cultured.

	<i>S. Albus</i>	<i>S. Aureus</i>	<i>C. Xerosis</i>	<i>M. pharyngis siccus</i>
5 minutes in 1 : 1,000 solution pot. permang.	—	—	—	—
2 minutes in 1 : 500 solution pot. permang.	—	—	—	—
Control .. .. .	+	+	+	+

These observations confirm Griffin's contention; the method is nevertheless not recommended for adoption since:—

(1) The length of time necessary to effect sterilization is not likely to be given in practice, and if given would increase the time necessary for the completion of "washing-up".

(2) Potassium permanganate cannot be trusted as a general disinfectant and it may moreover be used in an oxidised state when sterilization would fail to result.

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## PLAGUE IN THE NILGIRIS.

BY CAPTAIN R. S. VINE,  
*Royal Army Medical Corps.*

IN a healthy place like the Nilgiris plague is so unusual an occurrence as to be worthy of some note. I make no claim for originality in the following article but if I succeed in presenting a fairly interesting and readable account, especially for newcomers to the Corps, I am content. To begin with, a brief description of the Nilgiris to give an idea of the lie of the land, and also for the benefit of those who have never been there, may not be out of place.

### DESCRIPTION OF THE NILGIRIS.

The Nilgiris consist of a solid mass of hills formed by the junction of the Eastern and Western Ghats. It is a high, steep-sided plateau of an average height of 6,500 feet with several peaks running up to over 8,000 feet. The plateau is roughly rectangular, bounded on the west and south-west by a bold line of hills called the Kundahs, several of the peaks of which are over 8,000 feet in height. These rise precipitously from the plain of the Wynaad, a richly fertile plain covered for the most part by thick forest, of an average height of 2,500 feet above sea-level and continuous with the vast table-land plain of Mysore. The north, east, and remainder of the south edges of the Nilgiri plateau are not specially prominent, but fall steeply to the plains below.

Thus on the south-east and curving round to the north is the plain of Coimbatore, of an average height of 1,000 feet above sea-level; on the south-west is Malabar, slightly lower than Coimbatore; on the west, the Wynaad; north-west again a portion of Malabar, of equal height to the Wynaad, and the remainder of the north boundary, Mysore.

The foot-hills are clothed in dense steamy jungles which are for the most part highly malarious and rich in game; the slopes themselves are very steep, either bare rocky precipices or, wherever there is a foot-hold, clothed thickly in vegetation which varies progressively from tropical through sub-tropical to temperate vegetation as one rises. There are many tea and coffee plantations scattered over the plateau and on the few not too steep slopes. The western half of the plateau consists of magnificent open rolling downs of fine green turf of a height varying between 7,000 and 7,500 feet and covered with scattered copses termed "sholas." The eastern half is 1,500 feet lower and more hilly, covered in scrub and reserve forests as well as with the inevitable plantations. In the

centre, between the two halves, Dodda-betta, the highest peak, rears his rounded green head to a height of 8,650 feet.

A fine road extending from the north-west corner to the south-west divides the Nilgiri plateau obliquely into a northern and a southern half. In the north-west is the Gudalur Ghat road, a fine engineering feat, where the road winds down precipitous slopes to the Wynaad 4,000 below, to proceed eventually in a northerly direction to Mysore State. In the south-east the road winds down the fairly steep slopes of Mettupalaiyam Ghat, through reserve forests and plantations to the plains of Coimbatore.

The air of the Nilgiris is most refreshing, being cool and somewhat rarefied and deliciously scented by the faint tang of eucalyptus, derived from the numerous Australian blue-gum trees which are being constantly planted to solve the fuel problem.

The town of Ootacamund (Ooty for short) lies in the centre of the plateau at the base of Dodda-betta and is more or less surrounded by three other hills all over 8,000 feet. Coonoor is situated at the eastern end of the main road where the Mettupalaiyam Ghat begins, and is about eight miles from Ooty as the crow flies. Wellington Cantonment lies adjacent to Coonoor and nearer Ooty. The main road from Coonoor to Ooty passes through Wellington bazaar. Lorries laden with goods of all kinds are constantly passing along the main road as the small mountain railway (the first, I believe, to be built in the British Empire), which ascends the Mettupalaiyam Ghat, can only carry a limited weight.

#### DESCRIPTION OF OUTBREAK IN OOTACAMUND.

Plague is one of the easiest diseases in the world to diagnose and one of the easiest diseases to miss. In practically every fresh outbreak in a new centre, the first few cases go undiagnosed until the persistent and mysterious death of these cases in spite of treatment suggests plague. Once it is suspected it can very soon be confirmed or disproved. In the present outbreak a case was admitted to the Government Hospital, Ootacamund, on July 30, 1937. It was a child, aged 10, who gave a history of an injury and complained of pain in the right groin. A diagnosis of suppurating gland with septicæmia was made but an incision into the gland failed to reveal the presence of pus. The child died on August 1. The Civil Surgeon was away at the time and on return, in discussing the case with his staff, plague was mentioned but ruled out as improbable. The next case (aged 15) was admitted on August 10, 1937, and died four hours later. Plague was suspected but smear and culture from a gland were negative for *B. pestis*.

The third case was admitted on August 12, 1937, and died the same day. Again a negative result from the culture was returned from the Pasteur Institute, Coonoor. The fourth case was admitted to a venereal ward for



? venereal bubo. A post-mortem was performed and smears from the bubo were positive for *B. pestis*. The plague, though strongly suspected before, was not openly declared until positive bacteriological findings were established.

A careful house to house inquiry was then commenced and it was found that a number of the inhabitants who had developed symptoms suggestive of plague had migrated to various places in the Nilgiris and in the plains of Coimbatore from plague-infected portions of the Ooty. This is the usual difficulty one has to contend with in India. As soon as people commence to die mysteriously in any particular place, the ignorant and superstitious inhabitants keep quiet about it, as death certificates are unnecessary, and the bodies may be quietly disposed of, and the relatives quietly disappear from the neighbourhood, thereby disseminating the plague far and wide before the authorities suspect its presence.

In this instance human cases began to occur at the end of July, 1937, but the existence of an unusual mortality amongst rats was not brought to the notice of the authorities till August 12, 1937. It was not until August 17, when three wards of the municipality which surround the market were declared plague-infected, that reports of rat-falls were received from owners of private houses. All these rats were promptly examined and many declared plague positive; in these cases the houses were dealt with as described in connection with the outbreak in Wellington.

The present outbreak commenced, as one would expect, amongst the rat population of the market. Early rat-falls were suppressed by stall-holders who at first were unwilling to co-operate. The earliest human cases were traced to the houses in the immediate vicinity of the market, i.e. in one or other of the three surrounding wards, and some of the cases were actual workers in the market. Subsequently plague broke out in other wards, infection having travelled from the grain bazaar in one of the infected wards to grain shops in adjoining wards. Altogether six municipal wards were infected of which the three surrounding the market were the most severely affected.

The previous outbreak of plague in Ooty occurred in 1922-23 and lasted only three months. Rats caught and examined at intervals in the "free" period since were not found infected, proving that there was no endemicity of plague in Ootacamund.

The source of the present epidemic was not difficult to ascertain. As has already been pointed out, most of the merchandise of the Nilgiris arrives by road, either from the north-west corner via the Gudalur Ghat from such places as Malabar in the west, Coorg, Kanara, Mysore and places further north, or up the Mettupalaiyam Ghat from the plains further south and east. It follows, therefore, that the plague was imported.

The nearest infected area was Gundlepet in Mysore State. This town

and neighbouring villages have been infected with plague for some time past. Grain (rice) and millet (ragi) are imported from Mysore State into the Nilgiris and presumably infection was brought by a rat or fleas in a bag of these goods.

The subsequent spread of the epidemic proved clearly that infection travelled with bags of grain or millet from grain-store to grain-store. All the early human cases had a definite association with some grain-store or shop.

In Coonoor, positive rats were reported on August 18, 1937. These came from just outside Coonoor market in the place where the principal rice go-downs are situated. Coonoor was declared plague infected. The first human case occurred on September 23, 1937, i.e. thirty-six days later. Exactly one month later, September 18, the first plague-positive rat was discovered in Wellington Market, a distance of only 1 to 1½ miles from Coonoor market, and the first human case in Wellington, occurred, curious coincidence, thirty-six days later on October 23.

Measures adopted to combat the plague were:—

(i) *Notification.*—By the Cantonments Act 1924, Section 150, under penalty of a fine any outbreak of infectious disease must be notified immediately. As already mentioned the ignorant natives are frequently too scared to notify the authorities and prefer to slink off to some other neighbourhood.

(ii) *Declaration of Plague-infected Areas.*—This was publicly announced by the Collector of the District on the advice of the District Medical Officer. Movement of natives and merchandise to and from the place was controlled by the Police. Any native who entered the area from some outside non-infected area was not permitted to leave without production of an inoculation certificate.

In order to control the movement of grain (Ootacamund Municipality) .

(1) The market was closed and the grains were not allowed to be taken out until all the market stalls with their contents had been fumigated. All existing grain stalls in the town were listed and their stocks removed and fumigated in the improvised motor-lorry disinfector. Wherever a rat-fall had occurred the stalls, etc., were fumigated with their contents undisturbed.  
(2) Export of grains and potatoes from Ootacamund, unless previously disinfested, was prohibited.

Importation of goods from neighbouring districts was effectively controlled by locating a fumigation station at Gudalur and only fumigated products were allowed to enter the Nilgiris. A similar station was established by the Collector of Coimbatore at Mettupalaiyam.

(iii) *Closure of the Infected Buildings till Fumigated.*—The inhabitants were removed and housed in temporary shelters whilst the whole building, or in some cases the whole block, was made air-tight by pasting sheets of

newspapers over all the holes and cracks and fumigated with "Calcid" briquettes. This will be described in detail later.

(iv) *Anti-rat Campaign (in Wellington Cantonment).*—Temporary gangs of coolies were established under the supervision of the Sanitary Inspectors. These took it in turns to fumigate with cyanogas dust all the rat-burrows in the district. The rat runs were dug out and the number caught recorded daily. Any rat found dead other than from cyanogas poisoning, either by the gangs or private individuals, was sent to the Pasteur Institute, Coonoor. Some of these rats were found positive to plague. Immediately the building, shop or store associated with which the rat was found, was cleared of its inhabitants and fumigated. Subsequently, the grain was spread in the sun.

(v) *Isolation of Cases.*—In Wellington Cantonment a temporary shed constructed of bamboo matting in the Cantonment Hospital compound was used for nursing plague cases. The accommodation was sufficient for the few cases that occurred, but another site was ear-marked by the Cantonment authorities for the erection of further temporary sheds should a severe outbreak occur. In Ootacamund and Coonoor separate temporary isolation buildings were devoted to plague cases.

(vi) *Segregation of Contacts.*—Temporary camps with their own sanitary conveniences were erected. In Wellington a camp consisted of a couple of 160-pound tents borrowed from the Quartermaster of the unit stationed in Wellington. The camp was isolated as much as possible from the nearest dwellings.

(vii) *Inoculation.*—Anti-plague vaccine was obtained from the Haffkine Institute, Bombay. 3 cubic centimetres were generally injected in a single dose. 1 cubic centimetre with the remaining 2 cubic centimetres at a week's interval would probably have been better but this would have been impossible to arrange with the natives. If they received only 1 cubic centimetre they would probably never be seen again for their second dose. The military population was generally inoculated with 3 cubic centimetres in one dose, for the sake of convenience.

(viii) *Orders and Propaganda.*—Anti-plague regulations framed under Section 151 (1) of the Cantonments Act, 1924, were brought into force. Orders were issued by the Executive Officer under the advice of the Health Officer, Wellington Cantonment. Propaganda consisted of notices, posters, etc., prominently displayed advising people to be inoculated and pointing out the necessity of destroying all rats. A silent film was shown publicly in the market places illustrating the dangers of neglecting the precautions recommended. It was a pretty little story in which the villain and his accomplices die of plague and the hero and heroine come through unscathed because they were careful enough to be inoculated. The cleansing and fumigation of the dirty little go-down hovels wherein several families and

the inevitable cousins and connexions were housed, was clearly shown, and the infallibility of early inoculation driven home. This, like propaganda skilfully employed in other directions, was a most powerful weapon. Even so, house to house inoculation had to be resorted to in the end, particularly to get at women in purdah. In these cases the inoculator had to be content with merely an arm thrust through the curtains.

*Detailed Description of Measures adopted in Wellington Cantonment.*

(a) In the middle of August, soon after hearing of the prevalence of plague in Ootacamund, four rat catchers were employed and six dozen rat traps were purchased in addition to two dozen traps already available; 1,150 rats were bagged up to October 31, 1937. (b) Cyanogas blower and 80 pounds of cyanogas dust were purchased. Rat burrows are treated with cyanogas. (c) Temporary anti-plague regulations under Section 151 (1) of the Cantonments Act, 1924, were framed and enforced. (d) Anti-plague inoculations were carried out. (e) Propaganda on anti-plague measures by means of magic lantern demonstrations were made. (f) Owners of insanitary houses and houses containing rat burrows were served with notices to make their houses rat proof. (g) Any dead rat found within the Cantonment limit was immediately sent to the Pasteur Institute, Coonoor, for examination. (h) All grain shops and stalls in the market were disinfected once a week by exposing the articles in the sun and stalls washed with cresol.

The first positive rat-fall occurred on September 18, 1937, within the Wellington Market. The market was closed for two days and thorough fumigation of the godowns was carried out by means of calcid briquettes. One baby duster and twelve tins of calcid briquettes were purchased. Compulsory mass anti-plague inoculations were carried out. Rat catching and treating rat burrows with cyanogas were carried out more vigorously. More vigilance was exercised in allowing articles such as dry grains, cotton seeds, jaggery, potatoes, pulses and pressed fodder from outside areas to be brought into Cantonment. The market was ordered to be closed for half a day once a week to allow thorough disinfection of the stalls. When subsequent falls were reported the whole block of shops or houses wherein the rat was found or nearest the place where the rat was picked up was evacuated and fumigated.

Contact cases were isolated in tents and supplied with free rations whilst their quarters were being fumigated.

Anti-plague regulations stated that (1) All persons from plague-infected areas will be prohibited from entering Wellington Cantonment for residence until further notice.

(2) Persons from plague-infected areas will not be allowed within

Cantonment limits unless in possession of certificates of recent anti-plague inoculation.

(3) Dry grains, cotton seeds, jaggery, potatoes, pulses, pressed fodder will not be brought into the Cantonment from plague-infected areas unless the vendors are in possession of certificates of disinfection from the recognized Health Authorities of these Districts.

(4) Anti-plague inoculation will be made compulsory in Wellington Cantonment in case of an outbreak of plague. Voluntary anti-plague inoculation will be carried out daily at the Cantonment Hospital till further notice.

(5) The Plague Officer will be authorised to order evacuation of infected houses, or houses in their neighbourhood, or generally of any infected locality.

(6) The Plague Officer will be authorized to order the owner or occupier of a building, booth or tent used for public entertainment to close the same for such period as he may fix.

(7) Rat catching will be carried out daily by the temporary staff employed till further notice.

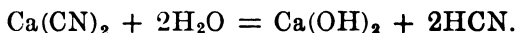
(8) All rat burrows in the vicinity of the Cantonment Market will be treated with cyanogas and the market and all stores disinfected once weekly.

(9) Inhabitants are urged to report any case of fever or glandular swellings or pneumonia to the Cantonment Hospital without delay.

(10) Any rat-fall will be brought to the Cantonment Hospital without delay for examination: it should be placed in a tin and soaked in kerosene.

#### CYANOGAS AND CALCID BRIQUETTES.

The basis in these substances is calcium cyanide  $\text{Ca}(\text{CN})_2$ ; in the first as a dust and in the second in the form of compressed briquettes of a specific size. The effective ingredient is the cyanogen radicle released in the form of hydrogen cyanide (HCN). On the basis of atomic weights of 40.1 for Ca and 52.0 for  $(\text{CN})_2$ , pure calcium cyanide would contain 56.5 per cent of the CN radicle. "Calcid" is chemically a very pure product, about 88.5 per cent  $\text{Ca}(\text{CN})_2$ , i.e. 50 per cent by weight of CN. This product give off its HCN almost immediately in the presence of moisture thus:—



The lime is rapidly changed into calcium carbonate by the presence of  $\text{CO}_2$  in the air and the final residue is an innocuous one, harmless to both human beings and plant life.

Each "calcid" briquette weighs 20 grams, containing 10 grams of available cyanogen. The machine is known as the "Baby Duster," a handy portable machine which can be worn fixed to a shoulder strap. It

consists of a metal case enclosing a grinder and fan which can be turned quite easily by a handle, and is so geared that a short turn of a handle causes quite a rapid revolution of the grinder and fan. A rectangular shaft fitting exactly a short column of "calcid" briquettes leads down to the grinder. A plunger fits in the shaft over the briquettes and keeps them pressed against the grinder by its own weight. When the handle is turned the briquette in contact with the grinder becomes powdered. The fan sucks the powder-charged air away from the grinder and blows it through a seven-foot hose-pipe attached to the machine. Quite a short turn of the handle is followed by a puff of smoke at the other end of the hose-pipe.

Cyanogas powder is worked by a pumping machine similar to a motor-tyre pump only larger. The powder is placed in a receptacle which fits on the end of the shaft of the pump and a hosepipe attached to the side of the pump carries the smoke away. The danger of poisoning when these machines are properly used is remote. No casualties occurred among the gangs working the machines.

The baby duster was used in the fumigation of buildings, and the cyanogas blower for rat-burrows. The great advantage of both of these methods is that rats are killed in their burrows and the sight of rats trapped and killed, offensive to some religious sections of the East, does not occur. Also the possibility of objectionable smells arising from the decomposed carcasses is precluded.

Much of the surrounding land is undermined by numerous intersecting burrows. In using the blower a fresh looking rat-burrow was selected and the end of the hose-pipe placed therein, moist earth being packed around to prevent escape of smoke. After a few pumps smoke was seen emerging from several openings, some many yards away. These were blocked up with moist earth and pumping continued till no more smoke appeared. Many of the embankments on the golf course were largely undermined and were a considerable expense to maintain. In view of the excellent results obtained by the Cantonment rat-catchers, the club wisely decided to purchase a cyanogas blower of their own and now not a single rat-burrow is to be seen on the golf course!

As soon as a building was declared plague-infected as the result of finding a positive rat-fall in its vicinity, or by the development of plague in one of its inhabitants, it was fumigated by the baby duster. The inhabitants were temporarily removed to the plague camp, being provided with free rations. All cracks, etc., were blocked by pasting paper over them and the hose-pipe attached to the machine placed inside the building. The number of briquettes required was calculated from the total volume to be fumigated, in accordance with instructions issued by the firm.

In stores and shops the bags of grain, etc., were left in situ and after fumigation thoroughly aerated by spreading in the sun before being sold to

the public. Specimens of foodstuffs containing moisture, which were thought likely to be spoilt by the fumigations, were sent to the Public Analyst, Government of Madras, by the Municipal Health Officer of Ootacamund; it was shown that they were free from hydrocyanic acid and fit for human consumption. It was also found that bags of rice, other grains and millets were capable of hiding fleas; these were discovered generally in the seams and just inside the canvas bags to depths of about an inch in the contents.

DESCRIPTION OF CASES OBSERVED IN THE CANTONMENT HOSPITAL,  
WELLINGTON.

The cases were few, presumably as a result of the intensive anti-rat campaign and the energetic anti-plague inoculations carried out at the Cantonment Hospital. Seven cases were admitted of which two died. The following are brief notes of the cases:—

*Case 1.*—Female, Mohammedan, aged about 22. Inoculated on September 28, 1937. Admitted on October 23, on account of high fever with pain and swelling in the right groin.

Patient toxic, with dry, furred tongue, sordes on the lips and teeth but no suffusion of conjunctivæ observed.

Temperature 103·2° F. Pulse 132, feeble volume. Respiration 30, shallow.

Liver and spleen not palpable. Bowels constipated.

In the right groin, the femoral glands were enlarged and extremely tender. Gland puncture revealed the presence of *B. pestis*; the culture was examined at the Pasteur Institute, Coonoor.

*Treatment.*—Prontosil, intramuscular 5 cubic centimetres, was given twice daily for three days. This was followed up by neutral iodine 2 cubic centimetres intravenously every second day. A stimulant mixture was given throughout. Particular attention was paid to the nursing, in respect of regular feeding, sponging, etc. "Glucose D" and brandy were given *ad lib.* Locally, unguentum iodi (in the form of "Iodex") was applied, and as soon as fluctuation was noticed the bubo was aspirated.

*Course.*—The temperature was continuously about 103-104° F. for the first two days. It then became remittent and on the fifth morning touched normal. After that the patient improved remarkably, but a slight discharge persisted from the needle-track of the gland puncture. She was discharged cured after a stay of thirty days in hospital.

*Case 2.*—Female, Mohammedan, aged 12. Uninoculated case. Admitted on October 26, 1937, on account of high fever with pain and swelling in the right axilla.

Patient toxic with white furred tongue and suffusion of the conjunctivæ. Slightly delirious.

Temperature 104° F. Pulse 136. Respiration 32. Liver and spleen were not palpable.

Examination of gland juice from bubo in right axilla showed presence of *B. pestis*, both in direct smear and culturally.

*Treatment*.—Prontosil, I.M. 5 cubic centimetres, once daily for five days. A stimulant mixture as above was given throughout but no neutral iodine. Nursing as before.

*Course*.—High fever and delirium lasted only forty-eight hours. Thereafter the temperature fell to normal by lysis during the subsequent five days. The bubo was aspirated twice. It healed in a short time, but a hard nodule was left behind which, in spite of the regular use of iodex, persisted till her discharge on November 21.

*Case 3*.—Male, Hindu, aged about 18. Uninoculated case. Admitted on October 30, 1937. There was fever with pain and swelling in the right axilla. Patient very prostrated. Tongue dry and furred: sordes on lips and teeth. Temperature 102° F. Pulse not perceptible. Respiration 36, very shallow. The bubo in the right axilla was ill-defined and mainly round the anterior fold of the axilla and over the pectoral region. The arm was paralysed. Examination of gland juice revealed *B. pestis* on direct smear and culturally.

*Treatment*.—Prontosil was not given in this case. Hypodermic injections of strychnine and digitalis were given every four hours on the first day. A course of six injections of neutral iodine was given on alternate days. Nursing as before.

*Course*.—The patient improved remarkably. On the morning following admission, his temperature was normal but became intermittent; it rose to 100° to 101° F. every evening for the next ten days. The bubo became more circumscribed and was aspirated twice. A serous discharge persisted from the puncture of the wound for a very long time which necessitated keeping the patient in hospital for fifty-seven days until it had quite healed.

*Case 4*.—Male, Mohammedan, aged 3½. Uninoculated case. Admitted on November 7, 1937, with pain and swelling in the left groin and fever. Patient fairly comfortable and did not look particularly ill.

Temperature 101° F. Pulse 126. Respiration 28. Examination of gland juice showed *B. pestis* both in direct smear and culturally. The direct smear was kept as a record by the Pasteur Institute, Coonoor, as it showed one of the heaviest infections with *B. pestis* seen in a smear from a human case, and was very similar to the picture obtained in a spleen-smear from a rat dead of plague.

*Treatment*.—No prontosil and no neutral iodine was given (injections were opposed by the parents). General measures, stimulant mixture as before and good nursing were relied upon and the bubo treated locally with iodex. It was aspirated as before, when fluctuation occurred.



*Course.*—The child made an uneventful recovery and was discharged after twenty-two days in hospital.

*Case 5.*—Female, Hindu, aged about 54. Uninoculated case. Admitted on November 29, 1937, in a moribund state.

Patient's eyes were bloodshot and she had a haggard appearance. She was violently delirious and nothing could be retained on account of severe vomiting. The right femoral glands were diffusely enlarged. Temperature 104° F. Pulse inperceptible. Respiration 36. She died three hours after admission. Gland puncture revealed presence of *B. pestis*.

She had been ill for at least three days in the bazaar before the illness was reported.

*Case 6.*—Female, Hindu, aged about 40. Uninoculated case. Admitted on December 5, 1937, with high fever and pain and swelling in the left groin.

The patient was fairly comfortable, and not particularly toxic in spite of continuous temperature of 103° to 104° F. which persisted for nearly a week. There was no delirium or blurring of the mental condition.

*Treatment* consisted of prontosil, I.M. 5 cubic centimetres, twice daily for three days and neutral iodine intravenous, thereafter.

*Course.*—Uneventful recovery: discharged cured on January 3, 1938.

This woman was the wife of a grain merchant.

*Case 7.*—Male, Hindu, aged 21. An immediate contact of Case 6. He, with several others, was isolated in the plague camp and was inoculated at the same time with the others.

On December 6, 1937, he was isolated; on December 8 he had bloodshot eyes and a characteristic drunken manner which quickly passed on to delirium. On December 9 slight swelling of the right cervical glands was observed and was evidently tender. On December 11 the patient died. Gland puncture showed presence of *B. pestis*.

This was the only typical textbook case of the series. He was evidently inoculated in the latent period and consequently developed the most severe toxæmia.

In these cases the stimulant mixture used was as follows:—

R	Tinctura digitalis ..	..	..	..	℥ x
	Spirit. ammon. aromaticus	..	..	..	℥ xx
	Tinctura nucis vom.	..	..	..	℥ x
	Aqua chloroformi ..	..	..	ad	℥ j

Sig.: ℥ j t.d.s.

The neutral iodine was as follows:—

R	Iodine ..	..	..	..	gr. v j
	Potass. iodi	..	..	..	gr. xxiv
	Aqua destillata ..	..	..	ad	℥ j

Made up aseptically and placed in sterile, glass-stoppered bottle.

*Dosage:* 2 c.c. intravenously on alternate days.

In Wellington, the first plague case that occurred was later discovered to be the wife of an Indian employee in the cycle-shop in barracks. True, she was separated from her husband, but no chances were being taken. The cycle-shop was cleared of its goods and carefully washed down with "Pesterine." This consisted of: Kerosene 20 parts, soft soap 1 part, water 5 parts.

In view of this occurrence, it was decided to inoculate all the men and married families, a measure which was commenced on November 2, 1937. A letter was drafted to the S.S.O. for publication in Station Orders.

This was as follows:—

"*Personal Prophylaxis.* So far as bubonic plague is concerned this consists in warding off the attacks of fleas and bed bugs.

"'Pesterine' is a good pulicide. It can be sprinkled over floors, bedsteads and walls. Flit or Shelltox sprayed over wooden floors and carpets in quarters, kills fleas very quickly.

"Plague is conveyed from rat to man by the rat flea and bed bug. Animals other than rats may serve as reservoirs of infection—domestic animals (in times of epidemic) may suffer.

"Certain forms of merchandise, especially grain and raw cotton, carry rats and fleas and should be avoided.

"When rats become ill or die, the fleas leave them and attack man. Certain rat fleas may remain infective for at least six weeks.

"There is an ambulatory form of plague in which the fever and prostration are slight. There may be some swelling and tenderness of the lymphatic glands and there is usually at the site of the flea bite a vesicle or pustule, this should be looked for.

"All three forms of plague present certain symptoms in common, e.g. sudden onset, sharp fever, dizziness, great prostration, a drunken gait, appearance and speech.

"The usual quarantine period is ten days. Exposure of bedding and clothes, mats, etc., to the sun (at 120° F.) for one hour is a valuable safeguard.

"It is of great importance to limit the food available for rats and to protect food supplies from their depredations.

"Rat destruction by the use of traps baited with tomatoes and scraps of fish should be carried out whenever practicable.

"All captured rats should be incinerated, but all ranks should be warned against handling dying or dead rats with their hands. Where rat-falls occur, the rat should be lifted with tongs or other appropriate implements and placed in a tin containing a little kerosene oil before despatching to the British Military Hospital, Wellington. Gloves should be worn before handling the rat."

A lecture on plague was given to troops by the medical officer in the Garrison Cinema and was followed by the film already described.

As a result of these measures, not a single case of plague occurred among the military population, and the disease rapidly faded out of the Cantonment which was declared free from plague by the Collector of the Nilgiris on February 5, 1938.

Plague has by this time practically disappeared from the Nilgiris but a few rat-falls and an occasional human case are still occurring in some of the remoter villages to which it has spread.

#### BRIEF DISCUSSION OF PLAGUE.

Except towards the end of the nineteenth century, plague as an epidemic disease was merely of historical interest. Then in 1896 it appeared in Bombay after an absence of 200 years. At that time it was raging in South China and as there was constant trade intercourse between Hong-Kong and Bombay it is believed that infection travelled by this route. True, plague was known to be endemic in remoter parts of India, but such a modern town as Bombay was considered invulnerable to its evil influence. It was a rude shock when plague not only ravaged Bombay but during the succeeding years spread to all parts of the Presidency and to other provinces in India. Much alarm was caused at the time, for it is evident, on studying the history of plague, that it has undergone a series of retrocessions and also recrudescences to violent devastating pandemics. These pandemics are characterized by diffuseness of spread or exceptional virulence or both, and have been self-limiting.

As already mentioned plague had been absent from Bombay for two hundred years; since the seventeenth century when it raged in Surat and Bombay for about six years, the intensity varying with the seasons. Now, with the outbreak at the end of the nineteenth century it was feared as the epidemic progressed, in spite of the early efforts of the authorities fighting to combat it, that the world was due for another pandemic. Plague has always spread by trade communications and, as these had extended and speeded up rapidly throughout the world, there was nothing to prevent an alarming pandemic throughout the civilized world. The best brains of the period worked tirelessly in Bombay, and the connexion between *B. pestis*, rats and fleas was elucidated.

Plague is essentially a disease of overcrowding, filth and foul air. In conditions of bad sanitation, human parasites, rats and their parasites, thrive and consequently the way is paved for plague. It cannot be too strongly emphasized that in attempting to eradicate the disease the primary object is to treat the soil in such a way that the seed of plague has no chance of growing and spreading. Fresh air and sunshine are powerful deterrents to plague. Plague-infected rats have frequently been

found dead in well-ventilated, clean houses without the inhabitants contracting the disease. Europeans in India are relatively immune for this reason. The reasonably satisfactory degree of sanitation obtained in a present-day controlled cantonment, coupled with a vigorous anti-rat campaign and mass inoculation, undoubtedly were the great deciding factors in the rapid control of the present outbreak.

My acknowledgments are due to Lieutenant-Colonel K. P. Mackenzie, R.A.M.C., Officer Commanding, British Military Hospital, Wellington, and Health Officer, Wellington Cantonment, for permission to forward this paper for publication, and for quoting in full the various orders and recommendations he issued in connexion with the outbreak.

I also acknowledge with gratitude the kindness of Lieutenant-Colonel G. Sloane Thomson, I.M.S. (retired), who lent me a copy of his "Treatise on Plague," first published in 1901, and that of Simpson's published in 1905.

My thanks are also due to the District Medical Officer of the Nilgiris, Major P. J. Kelly, I.M.S., and the Municipal Health Officer, Ootacamund, for supplying me with details of the outbreak in Ooty.

Lastly, but by no means least, my thanks are due to my Sub-Assistant Surgeon, Dr. K. P. S. Nambiar, of the Cantonment Hospital, Wellington, who throughout has co-operated in a skilful and helpful manner and upon whose shoulders rested the onus of carrying out the mass inoculations in the Cantonment and immediately supervising the treatment of the cases in hospital.



## Editorial.

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### CHOLERA.

IN the January number of the Journal this year we wrote an editorial on "Recent Researches on Cholera in India." In this the researches of Gardner and Venkatraman were described and a working scheme of the cholera group of vibrios was suggested. Gardner and Venkatraman found that all the standard cholera vibrios received from various laboratories and most of the vibrios isolated from cholera cases belonged to the "O" sub-group I and were non-hæmolytic. Gardner suggested that only non-hæmolytic vibrios of sub-group I should be accepted as proof of cholera or a cholera carrier. At a conference held at the League of Nations in 1935 it was decided that specific antigens for the cholera vibrio from which the non-specific "H" antigen had been removed should be sent to India. The antigens were prepared by Dr. Bruce White and tested by Dr. Gardner at the Standards Laboratory, Oxford. Two types were sent, the original Japanese type (Inaba) and the variant (Ogawa). Sera prepared by means of these antigens were used in India for testing strains recently isolated from cholera cases.

Reports were received from Kasauli, Shillong and Madras. Gardner, on perusing these reports, arrived at the conclusion that a serum containing specific "O" agglutinins but no "H" agglutinins will separate a group of vibrios, which without doubt cause epidemic cholera, from other vibrios whose pathogenic action is at least doubtful.

In May, 1938, Colonel A. J. H. Russell presented to the Permanent Committee of the Office Internationale d'Hygiene Publique, a note on further observations on the value of "O" agglutination for the diagnosis of the cholera vibrio by Colonel J. Taylor.

Colonel Taylor stated that experience in India has shown that agglutination by pure "O" serum constituted a sure method of diagnosis of *V. cholera*, and that reliance could not be placed on a serum containing "H" agglutinins. This opinion is based on numerous researches made into the characters of vibrio isolated from cases of cholera, carriers and from water.

Vibrios belonging to other serological types, especially to groups which possess antigens other than group I, and strains agglutinating with "H" + "O" serum, have been isolated also from a small number of cases of clinical cholera. These vibrios are widely distributed, particularly in water in Bengal and Northern India; they must frequently enter the intestinal tract and their presence in the fæces of both healthy persons and

those suffering from cholera is to be expected. They cannot, therefore, be regarded as the agent of cholera contamination. The only vibrios to which a definite cholera-genic action can be ascribed are those belonging to the "O" group No. 1 distinguished by the "O" agglutination test. In India they represent 86·5 per cent of the vibrios isolated from cholera cases.

In Calcutta, where cholera is endemic, during the cholera period (August, 1935, to September, 1936) 828 strains were isolated from clinical cases of cholera and of these 86·5 per cent were typical *V. cholerae* group "OI," non-hæmolytic and giving characteristic biochemical reactions. A study of the 13·5 per cent inagglutinable strains was made, making use of sera "O" prepared from selected strains isolated from clinical cases of cholera, carriers and from water which contained "O" antigens different from "OI." Of the seventy-nine strains thus grouped forty-five were agglutinated by serum Inaba "H" + "O," and five others not classified were also agglutinated by this serum. Those inagglutinable types were found in waters from different parts of India and in regions in the north where all possibility of cholera contamination could be excluded.

Observations on the distribution of the aquatic types have been extended and are important in regard to the signification of the inagglutinable forms isolated from clinical cases of cholera. The researches were carried on chiefly in the Punjab and North-West Provinces, and tanks and shallow wells were examined in non-epidemic regions, where cholera does not exist except on the rare occasions when it is imported from other parts of India. The method of examination was to enrich 200 c.c. of the water with peptone, and after twenty-four hours at room temperature a small quantity was placed in 10 c.c. of peptone water for six hours and inoculated on Aronson's medium specially prepared. This method always gave a culture of vibrios and among them several biochemical or serological types were isolated. In Assam, Bengal and Madras other workers obtained similar results. None of the strains isolated was agglutinated by the serum of group "OI." Vibrios, possessing in common with *V. cholerae* an antigen "H," were found to be widely distributed in the waters of India where there was no question of cholera contamination.

Experiments made at Kasauli showed that employing the enrichment methods the cholera vibrios are often outgrown by non-cholera vibrios. It is hoped that experiments now being made will provide an enrichment medium which is more selective of *V. cholerae*.

In connexion with the non-specific strains isolated from clinical cases of cholera, it is interesting to note that in Java, where there had been no cholera for seven years, out of sixteen strains examined nine were agglutinated by the serum Inaba "H" + "O." They were also agglutinated by the special sera "O" type employed in the examination of strains isolated

from cholera cases in Calcutta—none of these were agglutinated by the group “OI.”

The hæmolytic strains of “OI,” to which it is generally agreed the designation “El Tor” should be restricted, present a special problem. Their antigenic structure is identical with either the Inaba or Ogawa types and to distinguish them the tests for hæmolysins should be applied in the case of all “O” agglutinable strains.

In Italy Professor Russo has carried out an experimental study of the specific sera prepared by the Bruce White method or by culture on media to which chemical substances had been added to eliminate the “H” fraction. His report was presented to the *Officé Internationale d’Hygiene Publique* by Professor G. Petragani, Director General of Public Health.

In his first series of experiments Professor Russo immunized rabbits with dried “O” antigens of the Inaba and Ogawa types lent to him by the Standards Laboratory at Oxford, and other rabbits with a Napoli antigen obtained from a strain isolated during the Naples epidemic of 1911. These sera were tested on sixty strains of vibrios from the collection made by the Institute of Public Health, Rome. The results showed that the Inaba anti-serum contains active agglutinins which are specific for all proved strains of cholera vibrios and gives better results than the Ogawa and Napoli anti-sera, which agglutinate only at a lower titre.

In a second series of experiments “O” sera prepared with the same strains (Inaba, Ogawa and Napoli) cultivated on media to which various chemical substances had been added, viz., carbolic acid, alcohol and lithium chloride. Agar to which 0·5 per cent lithium chloride had been added proved to be the best medium. Sera prepared with cultures on this medium gave an agglutination of the Inaba strain at 1 : 6,000, of the Ogawa strain at 1 : 3,000, and of the Napoli strain at 1 : 2,000.

Dr. C. E. De Moor presented to the Cholera Committee an interesting report on a type of “El Tor” vibrio responsible for an epidemic having all the appearances of cholera in the southern part of the Isle of Celebes, Dutch East Indies.

In the months of September and October, 1937, about sixty kilometres to the north of Macassar, there was reported a small epidemic having all the appearances of cholera in several native villages either on the coast or some distance inland and also in a small island in the west about twenty kilometres from Celebes. Hardly had the epidemic disappeared, when in January, February and March, 1938, the disease was again reported in several native villages about ten kilometres to the south of Macassar and fresh cases to the north and south of the region first affected.

There was great difference in the severity of the cases. Some only lasted a few hours, suffering from collapse with rice stools and terminating in death, while others were merely choleraic diarrhœa. In 1938 the mortality was about 70 per cent.

The cases occurred in small areas, one or two cases a day at intervals of one or several days, or a week or even more. The disease appeared to be spread by contact and not by food or water. Carriers were discovered and might have been the cause of the sparse cases observed in the villages. The morbidity was 2 per 1,000 of the population, and the cutting short of the disease was probably due to sanitary efforts and to the treatment of well water with eau de Javel. About 95 per cent of the population were inoculated with a vaccine prepared from the causal vibrio: this produced no special reactions.

It was difficult to account for the origin of the disease. If it had been imported by the port of Macassar why should it have appeared only in small native villages sixty kilometres from the capital (Macassar), far from the main road and without any contact with fugitives from China? Native boats visit Singapore and Penang but are not likely to have introduced the disease as their voyages are prolonged for several months. For these reasons it was concluded that the disease could not have been imported but must be endemic in the south of Celebes.

Most of the vibrios isolated gave a positive but feeble Voges-Proskauer reaction and were hæmolytic. Dr. De Moor considered they belonged to the sub-group "OI" of Gardner and Venkatraman, and to type I of Heiberg. But being hæmolytic they were true "El Tor" strains.

Professor J. J. Van Loghein, of the University of Amsterdam, examined two cultures at the request of Dr. De Moor and agreed that they belonged to the type "El Tor." They were agglutinated by anti-cholera serum "OI" of Gardner and when heated to 56°—57° C. did not lose their agglutinability. In broth containing goats' blood they caused rapid hæmolysis in twenty-four hours.

The fact that an "El Tor" vibrio was associated with a highly fatal epidemic, with all the appearance of Asiatic cholera from the clinical, anatomo-pathological and epidemiological points of view, in the south of Celebes is unprecedented in the history of cholera in the Dutch East Indies.

The present existence of cholera in South China and the fact that the time occupied by the journey from Hong Kong to Manila is less than the incubation period of the disease has caused the United States to take steps to prevent cholera being imported by sea-borne traffic, especially by between-deck passengers. These measures, which have been in force since August 7, 1937, are based on the United States quarantine regulations which require the bacteriological examination of the stools of all persons coming from places where cholera is present. The provisions have been applied with the greatest discretion in order to cause the minimum of delay to ships putting into Manila, and only such passengers who,



after careful enquiry into all the factors involved, might be regarded as constituting a possible danger as carriers are subjected to bacteriological examination.

Some 64,817 persons between August 7 and December 22, 1933, passed through the quarantine station at Manila coming from infected or suspected ports; of these, 13,908 passengers for ports outside the Philippines were not subjected to any restriction other than the between-deck being isolated on board during their stay in Philippine ports, and in the case of passengers of other classes and the crew, of undergoing vaccination against cholera before being allowed to disembark temporarily. Of 21,074 other passengers bound for places in the Philippines 10,667 after careful examination and by a process of elimination, were exempted from the examination of stools, and 10,407 were subjected to this examination: of that number 298 or 2·6 per cent were found to show the presence of a vibrio in their intestines and all were given a dose of anti-cholera vaccine before disembarking.

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## Clinical and other Notes.

### VESICULAR DERMATITIS DUE TO WILD PARSNIP.

By MAJOR R. MCKINLAY,  
*Royal Army Medical Corps.*

CASES of vesicular dermatitis occurred amongst boys in the O.T.C. Camps at Tidworth Park and Tidworth Pennings in 1936.

At the latter camp some fifteen boys in reserve at the edge of a wood during exercises were all affected. The lesions were very typical of mustard gas burns.

All efforts to trace the causal agent failed, although various grasses, weeds, etc., and insects, such as ants, were suspect.

I was fortunate enough to discover accidentally the cause in the following circumstances. While waiting at Bulford for the Tidworth Mess Bus (coming from Salisbury) on Derby Day, 1937, a man employed cutting grass on the roadside came along and asked me if I knew of a good cure for blisters. On inquiring the cause of the blisters I was informed that they were due to wild parsnip. This man had numerous lesions in all stages from the fresh vesicle to the healed scar; some were septic due to secondary infection.

I arranged with him to come to my house the following Friday and bring a specimen of wild parsnip.

He duly arrived in the evening with what he described as "a good strong 'un." It was a very warm evening; I was mowing my lawn when he arrived and was warm and sweaty. I rubbed my forearm gently with (a) a piece of the broken stem, and (b) the yellow flower. A blister resulted in each case.

I am indebted to the Physiological Department, Porton, for the following description of my biggest blister. (I went over there to demonstrate the remarkable similarity to the early lesions caused by mustard gas.)

"Rubbed freshly cut section from stalk of wild parsnip on to flexor aspect of forearm on Friday, June 4, 1937. Erythema on June 5. Erythema with marked irritation, pain and œdema on evening of June 5. Progressed to vesication with œdema on Sunday, June 6, 1937.

"Monday, June 7, 1937.—Well marked œdema and erythema 7 by 3½ inches left forearm flexor aspect. Smaller area of intense erythema, partly covered with tiny vesicles approximately 2¾ by 1¾ inches surrounding tense vesicle 1½ by 1¾ inches. About 10 cubic centimetres of fluid was aspirated from this blister."

The weed is abundant on Salisbury Plain and is known locally as "Wild Parsnip," "Heel Trot" or "Hockweed." It belongs to the natural order Araceæ. It is variously referred to as *Heracleum* the common cow parsnip and *Pastinacea Sativa* the wild parsnip [1]. I am unaware if they are the same. The common name of parsnip is well deserved. The leaves are somewhat similar to the ordinary garden variety—the root is also very similar, even to the smell.

I subsequently blistered myself with six different specimens of the weed. Symptoms were uniform and came on about thirty-six to forty-eight hours after contamination. There was a marked erythema at the end of forty-four hours, with very fine dew-like vesicles just visible to the naked eye. At the end of forty-eight hours these fine vesicles had coalesced. Then the condition was very like a mustard gas burn, in fact there were no points clinically by which a differential diagnosis could be made. These blisters, unlike those caused by mustard gas, heal rapidly if treated aseptically.

I found the best treatment was to aspirate the vesicle and apply a sterile dry dressing, when the lesion healed in four or five days.

The resulting scar is somewhat fragile, in this respect also resembling mustard gas lesions, being thin, tissue-paper-like in appearance.

A bronzing then occurs, gradually disappearing. In my own case some of the scars were still visible after a lapse of six months. Even now after a year some can still be seen as a faint bronzing.

In places, such as the forearm, where the resulting scar is subject to friction or stretching, in the early stages it breaks down easily or cracks—secondary infection will then delay healing.

Although warned about the effects at the commencement of the 1937 O.T.C. camps, cases occurred. One boy who used a plant as a "fly-whisk" had numerous lesions on the face and neck caused by flicking himself with his improvised "fly-whisk."

In order to prove conclusively that the fifteen boys were thus infected in 1936 while in support in the wood already referred to, I accompanied Major Perez, R.A.M.C. (who was Senior Medical Officer, Tidworth Pennings, at the time of the occurrence) to the scene of operations, and we found lots of wild parsnip growing in the vicinity. I convinced him, to his entire satisfaction (although he started out as an unbeliever) by blistering him with two separate plants.

I have not succeeded in causing lesions on myself with every specimen I have tried, but I cannot remember failing with any when applied while hot and sweaty—this would appear to be a necessity—and is borne out by German research into dermatitis due to wild parsley [2].

There may also be a time in the development of the plant when it is more potent than at others, and the sensitivity of the recipient is also a probable factor [1].

The vesicant properties of this weed have been known for years. When I arrived at Porton on June 7, 1937, my attention was drawn to an article in *The Bulletin of Hygiene*, March, 1937, vol. xii, No. 3, on the dermatitis produced by this plant (and others), and to the full account of its properties described in the "Dermatergoses or Occupational Affections of the Skin," by Prosser White, pages 444 and 445.

My visit to Porton had a somewhat interesting and amusing sequel as the following paragraph from a London evening paper dated August 12, 1937, shows:—

"A SCARE AT PORTON.

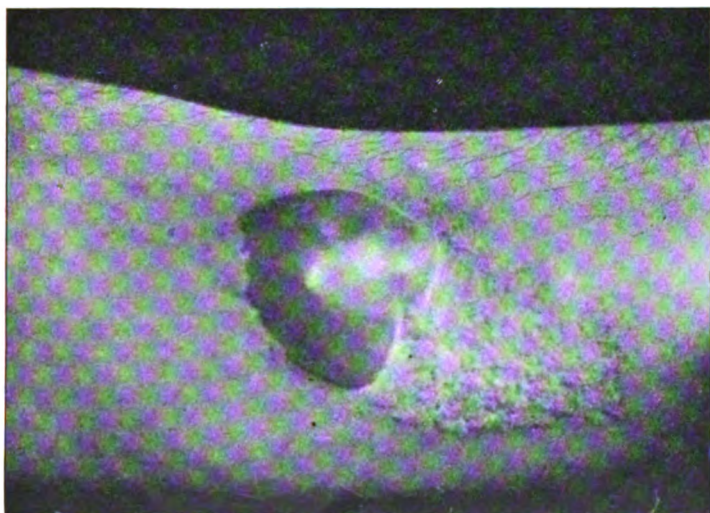
"Medical Officers at Porton Experimental Station had the same scare over poison gas infection as the London lads at the O.T.C. camps on Salisbury Plain.

"Not long ago a Blankshire County Officer found his arms and legs covered by a painful rash.

"The Officers at Porton at once suspected mustard gas poisoning.

"Later Dr. X. saw a ditcher clearing weeds with protectors on his arms. The roadman explained that when the wild parsnip flowered and was brushed by the arm it stung and produced painful wounds.

"Dr. X. recognized the flower in his orchard. He experimented and traced the rash."



Thinking he had been contaminated by mustard gas Dr. X. visited Porton several weeks after they had seen my blisters. He was reassured as to the real cause of his condition, and shown the photograph (reproduced) of my forearm, taken on June 7, 1937.

The following day—August 13, 1937—there was a paragraph of about fifty lines in a local paper headed, “The Wild Parsnip—A Doctor’s Discovery.”

#### SUMMARY.

(a) A dermatitis very similar to mustard gas lesions occurs as a result of contamination with wild parsnip under favourable conditions.

(b) It is essential for Army medical officers to be conversant with this fact in order that in war time cases of vesicular dermatitis due to wild parsnip may not be sent out of the line or otherwise subjected to special treatment and decontamination for non-existent mustard gas lesions.

(c) Although abundant on Salisbury Plain, its effects are not so generally known as they deserve.

(d) The effects have been known for many years. Jameson drew attention to it in the *Edinburgh Medical Journal*, 1897, as also did Stowers in the *British Medical Journal* in 1897.

I am indebted to Colonel S. G. Walker for his permission to send these notes for publication, and to the staff of the Physiological and Photographic Departments, Porton, for their help and assistance.

A most excellent coloured plate is now in the R.A.M. College Museum. Anyone seeing this will immediately notice the similarity of the effects to those of mustard gas.

#### REFERENCES.

- [1] “The Dermatogoses or Occupational Diseases of the Skin,” Prosser White, pp. 444, 445.
- [2] *Bulletin of Hygiene*, March, 1937, 12, No. 3, pp. 209 and 210.

### PRONTOSIL IN SMALLPOX

By CAPTAIN C. KING,

*Royal Army Medical Corps,*

AND

ASSISTANT SURGEON K. A. DE ROZARIO,

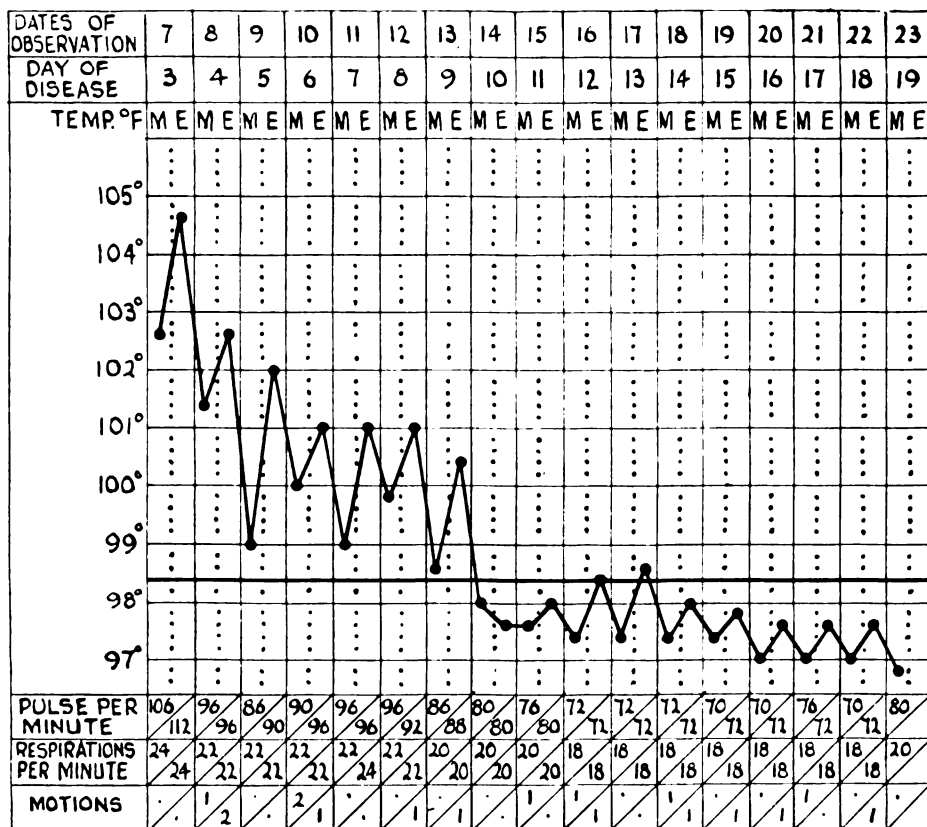
*Indian Medical Department.*

THE following account of a case of smallpox in which prontosil rubrum was used may be of interest:—

Mrs. B—, aged 33, the wife of Bandsman B—, was brought into hospital at 12 noon on December 7, 1937, with a history of having been taken ill about forty-eight hours previously with feverishness, headache, shivering and backache; on arriving in hospital she still complained of headache and backache, and her temperature was 102·6° F., pulse 106, respiration 24: no other abnormal physical signs could be found except a coated tongue and a few scattered rhonchi in the chest.

A blood-smear was examined and no malaria parasites were found. In the evening her temperature rose to 104.6° F., pulse 112, respirations 26, but no further signs or symptoms pointing to a diagnosis were observed or complained of during the day. Vaccination history was doubtful; only one rather indefinite set of marks was discernible, which she stated were her infancy vaccination marks.

December 8, 1937: Patient passed a fairly comfortable night, but



still complained of headache and backache; at about 11 a.m. a papular eruption appeared on the right arm and forehead, and was noticed on the legs during the day; the patient was placed in the isolation ward.

December 9: Eruption well marked on the back, arms, palms of hands, legs, soles of feet, and face, and a few papules were noticed on the chest and abdomen. Groins and axillæ were free from eruption. Patient no longer complained of headache and backache.

December 10: Majority of papules had become vesicular; some of the vesicles were umbilicated. Eruption was most copious on the face, arms, legs, back, and well marked on the palms of the hands and soles of the feet.

December 11: The eruption was well into the vesicular stage, umbilication being marked.

December 12: Vesicles were becoming turbid. Three tablets of prontosil given (one t.i.d. in error, three having been intended for one dose).

December 13: At this stage there was every indication of a severe attack with a serious prognosis. Eruption becoming pustular, seven prontosil tablets given during the day.

*Progress.*—Temperature remained normal until the patient was discharged from hospital on January 10, 1938. The pustules gradually dried up and scabs were formed. There was a certain amount of marking noticeable three months later.

A curious point in the distribution of the eruption was that the patient was left-handed and there were twenty-seven vesicles on the palm of the left hand and on the sole of the left foot, and twelve vesicles on the palm of the right hand and on the sole of the right foot.

The points of particular interest in the case are: (1) Prontosil was given as near to the beginning of the pustular stage as one could judge, definitely before a rise of temperature due to pustulation could have occurred. (2) That the secondary rise of temperature, which is part and parcel of every smallpox case, did not occur can have been only due to prontosil. (3) The diagnosis was not in doubt; three other medical officers who kindly saw the case agreed unanimously with the diagnosis.

We are indebted to Major J. A. C. Kidd, Royal Army Medical Corps, Officer Commanding, British Military Hospital, Nowshera, for permission to send the notes of this case for publication.

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## SHORT CLINICAL NOTES ON A CASE OF WIDESPREAD CALCIUM PHOSPHATE CALCULUS FORMATION.

BY MAJOR M. MORRIS,  
*Royal Army Medical Corps.*

RADIOLOGICAL investigation of Pensioner "C" showed widespread calculus formation in his urinary tract with obvious considerable destruction of renal tissue.

The history of this case is of great interest and briefly as follows: He was admitted to hospital on February 6, 1937, and discharged on March 11, 1938. He was admitted with a diagnosis of rheumatism or sciatica and during his year in hospital was operated on five times. The first operation, carried out on February 2, 1937, consisted in opening up the left hip-joint and head of the left femur where considerable osteomyelitis was

encountered. The second operation, eleven days after the first, consisted of an arthrotomy of the right shoulder at which the joint was found to be full of pus and was drained. *Streptococcus hæmolyticus* was grown from the pus after both operations. The remaining three operations were carried out on the hip and thigh later, and consisted in counter drainage. Twelve days after the shoulder-joint was opened the patient developed a septicæmic condition and hæmolytic streptococci were grown from the blood. Lieutenant-Colonel R. G. Atkins was responsible for the above-mentioned surgery.



I inherited this case in September. The shoulder-joint was in every way perfect, but the hip had considerable limitation of movement. He was, however, completely bedridden. This man was kept in bed because from time to time when allowed up he developed an abdominal crisis. This consisted in agonizing pain under the right and left ribs radiating upwards to the shoulders with a high temperature and suspicion of rigors. I found that the urine at these times was full of pus cells and red blood corpuscles and showed *Staphylococcus aureus* on culture.



Abdominal examination revealed nothing of interest. X-ray investigation resulted in the picture published with these notes and established the diagnosis: viz. widespread calculus formation with considerable destruction of both kidneys. Operative interference with both kidneys and ureters affected was to my mind obviously out of court. Treatment consisted in large doses of neotropin by the mouth and intravenously; large quantities of barley water to drink and atropine injections twice a day. I followed the case up and encouraged him to walk about between the attacks. I altered his recumbent attitude when in bed to a very upright Fowler position. After fourteen days walking about he commenced to pass stones; he has passed stones ever since and is still passing them! The stones are about the size of peas and he would pass eight to ten stones a day. His health improved so much and his urine became so much clearer that at his own wish he returned home and he has been out of hospital since March 11, 1938.

He writes from South Wales that he is in fair health, gets about and goes to the pictures, and still passes a few stones a week. He enclosed one about the size of a pea in his letter which is reported as consisting of calcium phosphate.

Points in this case of unusual interest and to my mind making it worth attention are:—

- (1) The widespread calculus formation in a few months.
- (2) The small amount of renal tissue required to function compatible with life.
- (3) The necessity of realizing what I am sure must be often overlooked, that chronic bone disease necessitating prolonged stay in bed in the recumbent attitude may be the direct causative factor of this dreadful condition.
- (4) Routine steps must be taken in these cases to counteract these conditions, viz. patients must be got out of bed with walking calipers, etc., as soon as possible and general anti-calculus treatment insisted on.

My thanks are due to Lieutenant-Colonel Hepple for his Laboratory reports, to numerous members of the Q.A.I.M.N.S. who have successfully nursed a very sick man through a long illness, and to the X-ray Department, Military Hospital, Tidworth, for the film.

NOTE.—A second X-ray photograph showed calculi in both kidneys.

## Echoes of the Past.

### A VOYAGE IN A TRANSPORT IN 1812.

RECEIVED FROM MAJOR-GENERAL ROBERT PRIEST, K.H.P.

EARLY one morning not many months ago the most modern of British troopships—H.M.T. "Dilwara"—steamed smoothly and silently out of the Suez Canal to continue her homeward journey. As she passed, her graceful lines and her beauty reminded me of a story in contrast I had read about a voyage in a transport a hundred or more years ago.

This story appeared in *The Monthly Panorama or Officers' Companion* for February 1813, which reads as follows:—

*Advice to Officers proceeding overseas.*

Off the Lizard, May 4, 1812.

Being at this moment sailing with a fair wind and smooth sea, although about half-way between Ushant and Cape Finistere, and enjoying all the advantages of a well-regulated society; I cannot resist a wish to describe the source from which we derive these comforts, for the advantage of all who may hereafter find themselves in a similar situation.

Our party consists of officers, surgeons, and commissaries. By a mutual inclination to accommodate each other, the four and twenty hours are so regulated that every thing passes as in a family:—we rise at seven,—breakfast at eight,—dine at two,—drink tea at six,—sup at nine, and retire to bed at ten. A time is allowed for washing out the cabin, and arranging *births*,—and, although we have two separate messes, yet the general anxiety for mutual accommodation prevents that confusion which would otherwise occur. Cards, back-gammon, and books amuse us alternately, and as the two former are confined to small stakes, there is nothing but an adverse wind and bad weather that can obstruct our harmony.

I subjoin a scale of ship allowances, etc., and a list of such articles of provisions it seems necessary an individual should take on board. Sea stock for one person, calculating the voyage at fourteen days, exclusive of the ship allowance:—fresh meat 10 lb., 3 couple of fowls, 1 lb. of tea, 4 lb. of sugar, 3 gallons of potatoes. In regard to wine and liquors, as the ship's allowance of spirits is ample, any provisions of that quality must be left to choice. Annexed is the ship's allowance; it being understood that officers draw exactly the same allowance as the private soldiers.

## SIX SOLDIERS' ALLOWANCE FOR EVERY DAY IN THE WEEK.

	Bread	Beer, gallons, or half pints of spirits or pints of wine	Beef, pieces of	Pork, pieces of	Peas	Oat- meal	Butter	Cheese	Vinegar	Water
	lb.		8 lb.	4 lb.	Pints	Pints	lb.	lb.		
Sunday ..	4	4		1	2					
Monday ..	4	4	1 or 6 lb. of			4	Half	1		
Tuesday ..	4	4	flour, $\frac{1}{2}$ lb.							
Wednesday	4	4	suet, and		2	4	Half	1		
Thursday ..	4	4	1 lb. raisins	1	2					
Friday ..	4	4			2	4	Half	1		
Saturday ..	4	4	1 or as above							

One quart  
A sufficient quantity  
for the time they  
may be on board

The above articles are in general good of their kind. I recommend a supply of soda water and chocolate to be laid in. The candles they allow on board for the officers are 12 to the lb. but they are generally broken and filthy; as for candlestick, unless the passengers have one, an old bottle must be the substitute. One inch of candle per night is all that is allowed for each passenger to drink his tea, eat his supper, and turn into his *birth*,—this requires no comment. I will give you a further idea of the liability with which unfortunate passengers are treated. Our master, like many other boisterous bullying heroes, is a married man,—and as the lady rules the *roast*, her commands when she is present, are indisputable. We have on board three surgeons and two commissaries, and, neither of them having a man-servant, they were much inconvenienced; this, I conceive, was a matter of delight to the woman, and, when parting from her literally better half, she strictly and clamorously enjoined in his two cabin boys, “on no account whatever to do any one thing for the cabin passengers.” But the boisterous Son of the Elements did fortunately consider, that as she was not present, there existed no immediate necessity for obeying her orders and having some faint sparks of humanity in his composition, winked at the little claims now and then made on the good temper of the boys; indeed I will do the man the justice to say, and I am supported by the general sentiment of those on board, that the woman seems to have taken with her the greatest share of the family ferocity. But I must observe that the Officers of government can possess but little feeling, when in giving gentlemen an order for a passage in a transport they launch them into a situation uncomfortable, cheerless, disgusting, and totally dependent on the rough and savage urbanity of a master of a transport,—a fellow who unfortunately has it in his power to make every thing uncomfortable, and who certainly never loses sight of that power. The man who is master of

this ship, for instance, was civilly solicited by the senior officer in the cabin, on account of a lady being one of the passengers, to lend a couple of flags or colours to be hung before the *birth*;—he at first acquiesced, but, repenting soon after, came into the cabin, and with great roughness and insolence, took one away;—the consequence of which is, that the lady, an invalid, is confined to a hole called the state room,—hot, noisome, close and unwholesome.

Government should consider that, as officers are not overburthened with money, every possible allowance should be made for their convenience. How much it is otherwise, the following narrative will disclose. An officer having embarked at Portsmouth, and purchased the utensils he unavoidably required, which, on his arrival at Lisbon, he found too cumbersome to take with him, was obliged to leave them at that place. After marching in the country for some time he was reembarked at another port, and had no alternative than either to supply himself with a fresh stock of utensils, or submit to the inconvenience and difficulties the want of them would subject him to. His finances would not admit of the former, and, in taking possession of his scanty and uncomfortable *birth*, the master of the ship described the mattress and blanket to have been often previously occupied by persons who had fallen victims to disease of various kinds, and gave it as his opinion, that the officer ran a great risk in sleeping on bedding which he had often reported as unwholesome, and should have been thrown into the sea. Why should not the government transport the troops in ships of war, and study a little the comforts of those who are to fight her battles? I assert as a fact, that masters are frequently put into these vessels who know not how to keep a reckoning, and who are very unfit persons to entrust the lives of our brave soldiers with. What can be said of the fellow who last November, coming from Lisbon under convoy, with near 400 soldiers on board, quitted the convoy,—and, ignorant where he was, cast anchor within a quarter of a mile at the back of the Isle of Wight,—and when fortunately getting a pilot on board, could hardly be persuaded he was not close to the Lizard; he could not believe he was in the channel;—and finally acknowledged that he had never in his life sailed there.

If the Transport Board would be more particular on this subject, and less indifferent to the accommodation of passengers, it would be more creditable to them. Conceive the forlorn situation of two young lads going out as clerks to the Commissariat: I had the following information from their own mouths. They got an order for a passage on board this ship, and came on board with their baggage about eight o'clock in the morning. The master, in the first instance, refused to let a sailor aid in taking their trunks on board;—the soldiers, however, good humouredly assisted them. As these young men were perfectly ignorant of the usage and comforts of

transports, and had conceived everything would have been furnished them, it was a matter of very great disappointment to find not one article of provisions was given them, nor did any means offer for their obtaining any until eight o'clock in the evening, when with difficulty they procured some biscuits from the steward : indeed the same savage disregard to the situation of these young men was manifested in every thing. The miserable poverty-struck mattress and blanket were withheld until asked for ; in short, one cannot but feel disgust that gentlemen should be subject to such brutality. All the ship allowances should be detailed on a sheet of paper, fixed in the cabin, and as little left as possible to the urbanity of a master of a transport ;—I might almost as well say the humanity of a wild hog. One fire-place is allowed for the soldiers, which is so placed and so occupied, that a passenger has little chance of ever boiling a kettle. In boisterous weather it is impracticable and, whether male or female, must go without a dressed dinner, etc., etc.

I would wish to call the attention of the worthy gentlemen presiding at the Transport Board, to the situation of females, who, from affection, interest, or some other cause, are fated to be passengers on board a transport. A case in point will best explain. Two ladies, wives to officers, were accommodated with the state cabin, which obliged them to go through the great cabin whenever they wished to go on deck for fresh air. As some passengers were sick it was not always consistent with delicacy that the ladies should pass through the cabin :—to remedy this inconvenience it was requested as a favour that a sort of curtain might be put up before the *birth*,—this was refused. I wish those gentlemen who regulate the transport, would enquire into these matters, and, for the sake of humanity, place things on a better footing.

Another, and a most unpleasant evil, arises from the indiscriminate manner of packing people together in these transports. One would hope that every man, who has received a liberal education, and who is found competent to fill a station in a profession which introduces a young man into good society, would understand that difference of manners which draws the line between the society of gentlemen and vulgar people. I found myself much disappointed in this particular instance in the little community on board the *Mariner*, by overhearing the following conversation between a young gentleman in the Commissariat, and a surgeon or hospital-mate. There was a lively, good-humored freedom in the Commissary, that at once indicated his wish to render himself agreeable. It appeared that the hospital-mate had got up in the night, and was fumbling in the dark at the cupboard ; this gave rise to some little good-tempered jokes from the other young men and amongst the rest the Commissary observed that Mr.— was certainly taking a quiet sup ;—to which the other replied “ IT WAS A DAMNED LIE.” The Commissary, I have no doubt felt a proper resentment

at this vulgar, rude insult, but satisfied himself with observing that no gentleman would make use of such low language, and as he could not consider him but as a vulgar brute, he should treat him with the contempt he deserved. Now, worthy Captain Paten, permit me to recommend your attention to the point of selecting the company for the different transports; consider that the passengers in each are to be associated for some time, and when even the most mild disposition may be ruffled by the disgusting treatment on board the vessels, added to which, perhaps, a long, rough, and boisterous passage; do, my dear Sir, let us at least be only subject to the hasty expressions of gentlemanlike language, and as it is very practicable to discern the gentleman from a man's appearance, conduct, or character, and particularly in a profession where education, we must suppose, is easily to be discovered, there can be no difficulty in classing the different ranks and disposing them in separate vessels—and not subject gentlemen to have their ears offended by language disgraceful to the lowest dregs of society. Allow me further to remark that as many of the officers of Government, employed in this service, are so perfectly careless in regard to the convenience of the officers in the Army, etc. it behoves you and each gentleman in like employments, to do all in your power to smooth the difficulties, and lighten the distresses of those whom you may have to dispose of in transports.

With regard to the embarkation of detachments of cavalry, I will point out what appears to me a very great error, and which may be done by my detailing the particular transactions of the little fleet in which I am a passenger. It is now scarcely one month since the horses of a detachment of cavalry were embarked. A convoy was appointed a few days after the embarkation had taken place, but the fleet did not sail for three weeks after. Having at length got into the Channel, it was found that different other vessels were in the convoy, traders, etc., and it so happened that most of the trading-vessels were bad *sailors*, the consequence was, to protect them the fleet was inconceivably delayed on the voyage, and many of the horses died. Surely it would be a better plan to send the detachments of cavalry together under a separate convoy, and, the moment after being embarked, take advantage of the first fair wind, and without delay, proceed to their destination. It is evident in this particular instance, the cavalry ships have been delayed more than fourteen days unnecessarily.

Masters of transports make much difficulty in delivering out the rations to the passengers, and in consequence, not half the allowance on a voyage is drawn by them. That which is undrawn goes into the pockets of these men, it amounts to a large quantity, and is a robbery on the Government. I should recommend that the passenger, on leaving the ship, should give the master a receipt for what rations he has drawn, who should be obliged to account for the residue. The masters certainly merit no sort of advantage, for they take all they can on every occasion. Adieu.

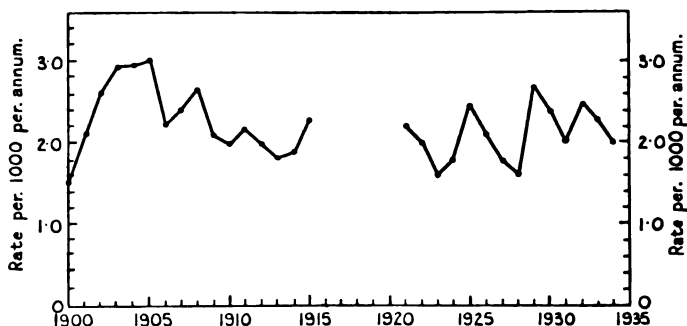
Those who, before reading the above, would have found it difficult to refrain from complaining that only an orange was supplied with their early morning tea brought to them by the cabin personnel, or perhaps that the 11 o'clock morning soup was not very hot when it reached them as they sat in the deck chairs supplied by the State, that the "iron-cow" behaved atrociously, or again, that the food was monotonous, should, after reading the account, find it more easy to sit quietly counting their blessings and thanking heaven that they have not to endure the shortcomings and discomforts of our predecessors, when proceeding on a tour of service abroad.

### Current Literature.

J. ROY. NAV. M. SERV. 1938, v. 24, 16—32, 2 figs. **Can an Extended Employment of Radiology be used to reduce the Incidence of Tuberculosis in the Navy?**

This article is divided into two parts (1) dealing with the statistics of tuberculosis in the Royal Navy, and (2) the possible practical application of X-rays for the detection and prevention of the disease.

In part (1) tables are given showing the numbers of recorded cases, numbers of ratings finally invalided out of the Navy and number of deaths for the pre-War period 1900-1913 and the post-War period 1921-1934.



Rates for officers and ratings (excluding Marines at Headquarters) finally invalided out of the Royal Navy on account of tuberculosis (all infections) since 1900. [Reproduced from the *Journal of the Royal Naval Medical Service*.]

Only 10 per cent of tuberculosis in the Navy is non-pulmonary. A graph is shown of the case-rate and death-rate per 100,000 as recorded since 1890. The early figures are regarded as open to error prior to 1906. The fall in death-rate is due to the speeding up in the procedure of getting cases of tuberculosis into sanatoria ashore as soon as possible after their discovery and perhaps partly also to the early discovery of cases. The invaliding rate is regarded as the most accurate index to the prevalence of tuberculosis

in the Navy. All definite cases of pulmonary tuberculosis are invalided, but the invalids figure does not include all the deaths because a patient may die after he has been invalided but before he has been discharged from a Naval hospital. The rates for Naval Officers and Ratings who are finally invalided out of the Service since 1900 are shown in a graph. This graph confirms the inference that there was some fall in the prevalence of tuberculosis between 1905 and 1913, but that there has been no further decline in the recorded incidence since that year. It seems possible, however, that the new entrants in the Navy are becoming more and more susceptible to infection with tubercle bacilli but that this increase in susceptibility is being balanced by improvements that are constantly being effected in the living conditions of the sailor. A comparison is made between the Navy and the other fighting services. During the period 1926-1930, 868 men were invalided from the Army with pulmonary tuberculosis, corresponding to a mean annual rate of 0.95 per thousand. In the Royal Air Force, in which the age grouping and length of service are more comparable with the Royal Navy, the rate was 0.88 per thousand for the same period, whilst during the same five years the rate for the Navy was 2.15 per thousand. Turning to the figures for different classes of naval officers and men for the decade 1925-1934 (*see* Table) it is seen that

TABLE—PULMONARY TUBERCULOSIS CASE-RATES. 10 YEARS, 1925-34.

Rank or Rating	No. of cases	Rate per 1,000 per annum
Commissioned Officers .. .. .	57	1.0
Subordinate Officers .. .. .	3	0.3
Warrant Officers .. .. .	9	0.9
Seaman Ratings .. .. .	775	2.2
Seaman Boys .. .. .	38	0.8
Engine-room Ratings .. .. .	485	2.2
Marines .. .. .	171	2.5
Sick-berth Ratings .. .. .	21	1.9
Officers' Domestic .. .. .	61	1.9
Writers .. .. .	21	2.6
Supply Ratings .. .. .	44	3.7
Telegraphists .. .. .	71	2.5

*Note.*—These groups do not comprise the total strength of the Navy.

commissioned officers have a rate of less than half that of the other ratings and it is difficult to ascribe this relatively low incidence of officers as compared with the lower deck to anything less than their relatively better and more spacious living conditions. The highest incidence is seen to be in the supply branch in which the men rarely appear on the upper deck and, other factors being constant, it is to be expected that they would suffer from tuberculosis more frequently than the average. Sick-berth ratings and officers' domestics have a lower morbidity than the rest of the lower deck. These groups are small, but it is suggested that although



they may come more often into contact with manifest cases of tuberculosis, they have a day and night environment in the sick bay which is better than the average, whilst in addition they spend about three-quarters of their service ashore in hospitals and other establishments. The higher rate in Marines is regarded as puzzling since they spend about one-third of their time ashore. It is suggested that most of the infections in this class are contracted whilst living on the mess decks of a warship or from carriers of tubercle bacilli returning to barracks after a commission at sea. The morbidity of Warrant Officers is about the same as that of Commissioned Officers, although Warrant Officers are all promoted from the lower deck. The evidence summarized therefore from this table is regarded as pointing to the risk of infection on the lower decks of a man-o'-war as being double that in the wardroom and double that of the Army and of the Air Force.

An analysis is next made of tuberculosis in the Navy by age and length of service. This is given in a series of four tables. The first noticeable feature is that whilst at the beginning of the century about half the cases of tuberculosis were discovered during the first five years of service, at the present time only 16 per cent are found so early in their career. There has been a reduction in the number and frequency of cases amongst the younger and junior groups of the Service. In the early period, when the Service was composed of younger men, there was little difference in the incidence of tuberculosis in the under 25 and the 25 to 35 age-groups. In the recent period, however, the youngest age-group is seen to suffer significantly less from tuberculosis than the others, excluding the age-group over 45. In the re-grouping of the cases with regard to seniority, it is seen that the incidence of tuberculosis is definitely lower during the first five years of naval service, but there is no significant difference in the invaliding rates of the remaining four seniority groups. The author remarks: "One would have imagined that any man who survived the risks of infection under the close conditions of a life at sea for fifteen or twenty years ought to be immune to tuberculosis, but, as a matter of fact, the risk of developing phthisis is as great after twenty years' as after five years' service in the Navy." The incidence among lower deck ratings is 0.9 per thousand per annum during the first year of service and averages 1.7 for the next four years and then remains practically steady at 2.3 per thousand per annum. The shape of the age-incidence curve of morbidity in the Navy corresponds closely with the curve of mortality in England and Wales, where the mortality rises abruptly between the ages of 15 and 25 and then remains more or less level until after 45 but falls rapidly about the age of 55. It is noticeable that small outbreaks of four to ten cases may occur in one ship. Such outbreaks may represent an annual morbidity of 1 to 4 per cent of a ship's company or an incidence 5 to 20 times the expected morbidity.

A comparison between this naval phthisis morbidity and civilian morbidity is difficult, but reasons are given for suggesting that a 2.3 case-

rate in the Navy may not be so very much in excess of the corresponding rate ashore. The latter includes cases of tuberculosis from dangerous "dusty" and other trades and from areas where the standard of living is far lower than that in the Royal Navy, which is a selected population that has passed through the sieve of a stringent medical examination. In concluding this part of the record, it is observed that in spite of the improvements that have been made in the diet, hygiene and living conditions of the Navy the recorded incidence of tuberculosis fails to decline and the inference is drawn that the English young male adult is more susceptible—rather than more immune—than formerly to phthisis.

Part (2) is an analysis of the assumption that the removal of early cases from the Naval environment before they become open cases would reduce the number of sources of infection. Two views are stated : (1) That the majority of the cases entering the Navy are those of arrested infancy or childhood tuberculosis ; (2) That contact infection takes place in the Service. It is estimated that the X-ray examination of 5,000 recruits required annually for the Navy would yield about fifty cases of tuberculosis on radiographic examination. With regard to contacts, arguing from the civilian figures of Sir Arthur MacNalty, it is estimated that the X-ray examination of 2,000 contacts would yield 180 cases of active or arrested tuberculosis. To invalid scores, perhaps hundreds, of healthy valuable trained men with permanently arrested tuberculosis would be impossible. Lastly, to examine the whole Navy as rapidly as possible and remove all positive cases found, with the idea of eradicating tuberculosis once and for all is only a tenable proposition if all cases of phthisis are the result of contact infection in the Navy. It would mean over 300 radiographic investigations a day with possibly eight whole-time radiologists and some twenty-four X-ray attendants at a cost of about £50,000. Moreover, the examination might have to be repeated at intervals. At present it is regarded as premature to embark on such ambitious schemes, and it is considered to be impossible to be certain that they would have any appreciable effect on reducing morbidity of pulmonary tuberculosis in the Service. The wiser and more practical scheme would appear to the author to be to make a test investigation of recruits and apparently normal trained Naval personnel in order to find out the magnitude of the problem to be dealt with.

S. ROODHOUSE GLOYNE.

*Reprinted from "Bulletin of Hygiene," Vol. 13, No. 7.*

## Reviews.

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THE DOCTRINE OF SIGNATURES. A Defence of Theory in Medicine.  
By Scott Buchanan. 1938. Pp. xiv + 201. London: Kegan Paul,  
Trench, Trübner and Co., Ltd. Price 7s. 6d.

This volume forms part of the International Library of Psychology, Philosophy and Scientific Method. Its author points out that whereas at first sight there seems little or no connexion between grammar, rhetoric and logic on the one hand and between diagnosis, prognosis and therapeutics on the other, nevertheless the fundamental aim of each group is the same, namely the evolution of ideas from a collection of apparent facts. The Doctrine of Signatures advocates the search for universal abstractions or ideas in signate matter, whether in philosophy or science.

In ancient times philosophy included all the known sciences, and even in the universities of the Middle Ages a course of the liberal arts was considered essential for the study of medicine. In modern times there is a sharp distinction between the so-called arts and sciences, and, furthermore, there is an even sharper and more hostile distinction between ancient and modern medicine. According to the Doctrine of Signatures, these distinctions are not only fallacious but unfortunate in the extreme. The root causes of these unhappy divisions are rationalization and decentralization.

The mysticism and superstitions of the Dark Ages were eradicated by the cold, calculating light of the Age of Reason. Quacks were exposed and false theories exploded. The philosopher was relegated to his teleological theories. The scientist settled down to hard facts. The scientist, however, forgot that the hard facts of to-day were but the hypothesis of yesterday, and was oblivious of the fundamental fact that the discarding of theories would inevitably tend to diminish materially the birth of new facts.

The tendency of all modern science, including modern medicine, is decentralization. We are living in an age of specialization. The philosophers of ancient times also specialized, but in an entirely different sense. Galen brought all his vast knowledge to bear on the study of the human body, and thus laid the foundations of modern medicine. His signatures, or theories, or ideas, or potential facts, call them what you will, were culled from all branches of knowledge and dealt with the human organism as a whole. The bacteriologist of to-day knows little about the work of the nerve specialist and probably less about that of the psychiatrist or the psychologist. There is no doubt that work of the most valuable kind is

being done and that steady progress is being maintained in all branches, but the author of the Doctrine of Signatures sounds a grave note of warning.

Perhaps the concrete example of a house may make his meaning clear. In order to erect a permanent structure, the foundations must be solid. The height of the structure will naturally depend on the solidity of the foundations. An increase in height will involve the broadening, deepening and strengthening of the foundation. The foundations of modern medicine are undoubtedly to be found amongst the ancients, and unless a deeper and fuller study is given to the ancients, further progress may be limited if not eventually checked.

J. B.

THE SEASONAL PERIODICITY OF MALARIA AND THE MECHANISM OF THE EPIDEMIC WAVE. By C. A. Gill, Colonel, I.M.S. (Retd.), M.R.C.P.Lond., M.R.C.S.Eng., D.P.H., D.T.M. & H.Eng. Pp. 136, map, and 17 illustrations. London: J. and A. Churchill. Price 10s. 6d.

The writer divides the globe into four zones in which malaria, especially as regards its epidemiology, presents certain special characters.

The *temperate zone* is typified by Holland, the *subtropical zone* by Southern Italy, the *tropical zone* by Northern India, and the *equatorial zone* by Ceylon.

In all zones a spring wave and an autumn wave of malaria are recognized. The spring wave with rare exceptions consists essentially of delayed cases or relapses, the autumn wave of both fresh cases and relapses.

In the temperate zone the majority of the cases in the well defined spring wave are the primary manifestations of malaria contracted in the previous season of infectivity. The autumnal wave is, in consequence of this tendency towards delay, small and ill-defined.

In the subtropical zone there is a well-marked spring wave of benign tertian malaria, the cases being almost entirely relapses of infections which gave rise to symptoms the previous year. The autumnal wave, which is much higher than the spring wave, is made up of combined malignant tertian and benign tertian fresh cases and relapses.

In tropical zone malaria the waves are very similar to those of the subtropical zone, differing only in the later onset and, as a rule, much greater severity of the autumnal wave, of which the intensity corresponds closely with climatic humidity.

In equatorial zone malaria the two seasonal waves are of low but almost equal amplitude. The spring wave differs from that in other zones by containing fresh infections as well as relapse cases. An interesting point is that in the equatorial zone the intensity of malaria is enhanced by *deficient* and not by excessive rainfall.

The composition, periodicity, form and nature of the seasonal waves

are discussed in detail. The author attaches great importance to the relapse factor, and believes that the autumn wave, like the spring wave, begins with relapses. Except in equatorial and, rarely, in tropical zones, conditions in spring are unsuitable for transmission, and hence, no primary cases occur at this time. In autumn, however, transmission is possible and successive waves of fresh cases follow the initial wave of relapses. No explanation can be given of the cause of seasonal relapse, which is assumed to be the expression of a qualitative change in the malaria parasite or in the parasite-host relationship.

It is not possible to summarize the intricate arguments with which the author supports his thesis, and for these the reader must refer to the original. While he may not find himself in agreement with certain of the conclusions which are reached, he will undoubtedly be repaid by a stimulating exposition of a very important aspect of the problem of malaria epidemiology which rarely receives the attention it merits.

J. M. B.

A SURVEY OF CHRONIC RHEUMATIC DISEASES. By Various Authors. 1938. Pp. viii + 338. London: Humphry Milford, Oxford University Press. Price 18s. net.

This book has been compiled by various authorities on chronic rheumatic conditions in commemoration of the bicentenary of the Royal National Hospital for Rheumatic Diseases, Bath. The history of chronic rheumatism is related by Sir Humphry Rolleston. This is followed by an article by Dr. Fernand Bezancon and Mathieu-Pierre Weil on the rheumatic diathesis.

The difficult problem of the relationship of rheumatic diseases is dealt with by Dr. F. J. Poynton. He concludes that "rheumatisms" are more allied to one another than to any other disease.

The importance of micro-organisms in the production of rheumatoid (atrophic) arthritis is discussed at some length by Dr. Philip Hench of the Mayo Clinic. The present day view aided by the new serological procedures incriminates the hæmolytic streptococci.

Dr. Wilfred Edgecome considers the metabolic and endocrine background of arthritis. The pathology of non-specific arthritis is dealt with by Dr. Ralph K. Ghormley. Dr. Gunnar Kahlmeter considers the sedimentation rate in arthritis.

A good summary of the changes in the circulation in chronic arthritis is given by Dr. Ralph Pemberton. It has been shown that there is a decreased rate of exchange of materials between the tissues and the blood as it passes through the peripheral tissues. As a result the basal metabolic rate is lowered, there is a decreased rate of sugar removal and an increased percentage of saturation with oxygen in the venous blood. There is also

present an increase of the extravascular fluid in the articular and peri-articular tissues.

Dr. W. S. C. Copeman writes on the rheumatoid syndrome and points out that this group can be divided into the primary form, typically affecting females in early life and running a rapid course, and secondary type where an infective focus is more frequently found, the removal of which leads to great improvement.

Dr. S. W. T. Patterson deals very shortly but adequately with the nature of fibrositis and spondylitis, the differential diagnosis and treatment of the principal forms is detailed by Dr. C. W. Buckley, and emphasis is laid on the importance of recognizing early and treating efficiently spondylitis ankylopoietica or ankylosing spondylitis.

The difficult problem of the pathogenesis and ætiology of sciatica is tackled by Dr. Folke Lindstedt. He considers that in every case a complete general investigation is called for as well as a search for local causal factors. The question of gout is dealt with by Dr. F. G. Thomson. Dr. Bernard Schlesinger discusses Still's disease. Freund reviews the biochemical changes found in rheumatic disease. A résumé of the literature on the pharmacology of chronic rheumatism is given by Dr. A. H. Douthwaite in which the specific and non-specific drugs for this condition are dealt with.

The orthopædic aspect of this group and the help that surgery can give are also considered.

This book is well worth a careful perusal.

A GUIDE TO HUMAN PARASITOLOGY. By D. B. Blacklock, M.D., D.P.H., D.T.M. and T. Southwell, D.Sc., Ph.D., F.R.S.E. Third Edition. Pp. viii + 259. London: H. K. Lewis and Co., Ltd. Price 12s. 6d. net.

The old adage tells us that good wine needs no bush, and so little is necessary in this note except to announce the issue of a third edition of "Blacklock and Southwell." The sections on malaria and leishmaniasis have been entirely rewritten where necessary, elsewhere the text has been brought up to date, and all the excellent qualities that distinguished the earlier editions and insured their success have been retained.

W. P. MACA.



## Notices.

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### COMMANDANT, OFFICERS' CONVALESCENT HOME, OOTACAMUND.

APPLICATIONS are invited for the post of Commandant of the Officers' Convalescent Home at Ootacamund from retired European officers of the Royal Army Medical Corps, late Royal Army Medical Corps, or Indian Medical Service.

The terms of the appointment are :—

- (i) Salary of Rupees 300 per mensem in addition to retired pay plus free quarters, lighting, fuel and board, for himself and his wife, who will assist him.
  - (ii) The tenure will be for so long as the officer's services are required and will be subject to three months' notice on either side.
  - (iii) The officer will normally be required to vacate the appointment on attaining the age of 60. An extension for a specified period may, however, be granted.
  - (iv) The services of the Commandant may, at any time, be liable to be dispensed with in the event of any misconduct or neglect of duty on his part, of which misconduct or neglect His Excellency the Commander-in-Chief or his authorized representative shall be the sole judge.
- (2) Applications should be addressed to the General Officer Commanding-in-Chief, Southern Command, Poona, India, and should reach him by January 1, 1939, at the latest. The selected officer will be required to join the appointment about March, 1939.
- (3) This supersedes the "Notice" published in the June and July issues of the Journal.

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### FOURTH INTERNATIONAL CONGRESS OF COMPARATIVE PATHOLOGY.

ROME—MAY, 1939.

THE Congress of Comparative Pathology which is to be held in Rome from May 15 to 20, 1939, promises to be of very special interest. Professor Rondoni, Member of the Royal Academy of Italy and Director of the Cancer Institute at the University of Milan, will be the President, and already about twenty reporters have been chosen for the following subjects :—

- (a) Ultravirus diseases.
- (b) Heredity in pathology.
- (c) The association of antigens and their function.
- (d) Regressive processes in plants.

The British reporters include Professor F. A. E. Crew on "Heredity in Pathology," and Professor J. R. Marrack on "Antigens."

The Congress Committee will be glad to receive shorter communications on any of the above-named subjects not later than March 31, 1939.

The Secretary of the Congress is Professor Zavagli at the address : Consiglio Nazionale delle Recerche, Piazzale delle Science, Rome, to whom such communications should be sent.

The membership subscription is 250 lire, or in English money £2 12s. 6d. This subscription gives the right to reduced rates granted by the railways, shipping companies and hotels ; to participate in all excursions and ceremonies, including the banquet, and to receive the general reports of the Congress The ladies' subscription is 100 lire, or £1 1s.

Subscriptions may be sent to the Secretary of the British National Committee, Dr. Bullock, at 9, Red Lion Square, London, W.C.1, who will undertake to pass them on to the Secretary in Rome.

The last date for the reception of subscriptions by the Rome Secretariat is March 31, 1939.





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